B
000 009 679 2
UC SOUTHERN REGIONAL LIBRARY FACILITY
alifornia
gional
cility

LIBRARY

THE UNIVERSITY
OF CALIFORNIA

SANTA BARBARA

FROM THE LIBRARY OF
MRS. H. RUSSELL AMORY.

GIFT OF HER CHILDREN
R. W. AND NINA PARTRIDGE.

Y ;

S,

[., &c

)GY

ET.

PA153 William

PALEY'S

NATURAL THEOLOGY;

WITH

ILLUSTRATIVE NOTES,

BY

HENRY, LORD BROUGHAM, F.R.S., AND SIR C. BELL, K.G.H., &c.

AND AN INTRODUCTORY

DISCOURSE OF NATURAL THEOLOGY,

BY LORD BROUGHAM:

TO WHICH ARE ADDED,

SUPPLEMENTARY DISSERTATIONS,

AND A TREATISE ON ANIMAL MECHANICS,

BY SIR CHARLES BELL.

WITH NUMEROUS WOODCUTS.

IN FOUR VOLS. VOL. III.

LONDON:
CHARLES KNIGHT & CO., LUDGATE STREET.

1845.

LONDON: WILLIAM CLOWES AND SONS, STAMFORD STREET.

CONTENTS OF VOL. III.

CHAP. XVII.—THE RELATION OF ANIMATED BODIES TO INANIMATE NATURE.

Wings of birds—fins of fish—air and water, 5 ; ear to the air, *ib.* ; organs of speech—voice and respiration to air, 6 ; eye to light, *ib.* ; size of animals to external things, *ib.* ; of the inhabitants of the earth and sea to their elements, 7 ; sleep to night, *ib.*

Note 1, referring to the Appendix for observations on the bones of large animals, 7 ; 2, on the succession of day and night and on the changes of the seasons, with reference to the happiness of animals, 9.

CHAP. XVIII.—INSTINCTS.

Incubation of eggs, 12 ; deposition of eggs of insects, 17 ; solution from sensations considered, 21.

Note 3, on the unchangeableness of animal instincts, 12 ; 4, on the instinct of the chicken in breaking the shell of its egg, 14 ; 5, on the natural and instinctive feelings of man, 19 ; 6, on the arguments of sceptics, and on compensations in animal organs and powers, 23.

CHAP. XIX.—OF INSECTS.

Elytra of the scarabæus, 28 ; borer of flies, 30 ; sting, 31 ; proboscis, 32 ; metamorphosis of insects, 35 ; care of eggs, 38 ; observations limited to particular species, 39 ; thread of silk-worm and spider, *ib.* ; wax and honey of bee, 40 ; sting of bee, 42 ; forceps of the panorpa tribe, *ib.* ; brushes of flies, *ib.* ; glow-worm, 43 ; motion of the larva of the dragon-fly, 44 ; gossamer spider, *ib.* ; shell animals, 45 ; snail shells, *ib.* ; univalve shell-fish, 47 ; bivalve, 48 ; lobster shell, *ib.* ; variety of insects, 49.

Note 7, on the antennæ of insects, 27 ; 8, on the word *coleoptera*, 29 ; 9, on the wing-cases of *brachelytra*, *ib.* ; 10, on the wing-cases of the genera *molorchus*, *ib.* ; 11, on the genus *Hister*, *ib.* ; 12, on parasitical insects, 30 ; 13, on the ovipositors of insects, 31 ; 14, wimble of insects an ovipositor, *ib.* ; 15, stings of insects used as ovipositors, *ib.* ; 16, anatomical description of the proboscis of the bee, 32 ; 17, on the indentation in the head to receive the proboscis, 33 ; 18, on the parts of the mouths of insects, *ib.* ; 19, referring to note 18 ; 20, on the habits of bees in collecting food, &c., 34 ; 21, description of the parts of the mouth of the common flea, 35 ; 22, on the structure of the mouths of caterpillars, *ib.* ; 23, on the difference between the larva and the perfect insect, 37 ; 24, on bees' wax, 41 ; 25, on the construction of the cells of bees, *ib.* ; 26, on the genus *Trichius*, 42 ; 27, on the mode in which the stag-beetle cleans its antennæ, *ib.* ; 28, on the glow-worm, 43 ; 29, on the glow-worm's light, 44 ; 30, on the manner in which the spider attaches its thread to different bodies, 45 ; 31, on the number of the species of insects, 49 ; 32, number of the species of butterfly in this country, 50 ; 33, on insects subsisting on carrion, 51 ; 34, on the similarity between the improvements in paper-making and the construction of *wasp-paper*, and on the migration of birds, *ib.*

CHAP. XX.—OF PLANTS.

Preservation, perfecting, and dispersing of seed, 53 ; germination, 61 ; tendrils, 62 ; particular species, 64 ; vallisneria, *ib.* ; Cuscuta Europæa, *ib.* ; misseltoe, 66 ; colchicum autumnale, *ib.* ; dionæa muscipula, 68.

Note 35, on the structure of buds, 55 ; 36, correction of the text, 63 ; 37, on the *Cuscuta Europæa*, 65 ; 38, on parasitical plants, 66 ; 39, no attracting syrup on the leaves of the dionæa, 68 ; 40, description of the pitcher-plant, 69.

CHAP. XXI.—THE ELEMENTS.

Consolidation of uses, 71 ; i. air, 72 ; reflecting light, *ib.* ; evaporating fluids, *ib.* ; restoratives of purity, 73 ; ii. water, 75 ; purity, *ib.* ; insipidity, *ib.* ; circulation, *ib.* ; iii. fire, 76 ; dissolvent power, *ib.* ; iv. light, 77 ; velocity, *ib.* ; tenuity, 78.

Note 41, on the purification of the air by the respiration of plants, 73 ; 42, on the purification of the air by the agitation of water, 75 ; 43, on the adaptation of the conducting powers of different substances to the wants of the animal and vegetable kingdom, 77 ; 44, on the composition of light, 78.

CHAP. XXII.—ASTRONOMY.

Fixing the source of light and heat in the centre, 83 ; permanent axis of rotation, 86 ; spheroidicity of the earth, 88 ; of centripetal forces, 90 ; attraction indifferent to laws, 91 ; admissible laws within narrow limits, 93 ; of admissible laws, the present the best, 95 ; united attraction of a sphere, the same as of the constituent particles, *ib.* ; the apsides fixed, 96 ; figures of the planetary orbits, 101 ; Buffon's hypothesis, 102.

Note 45, on the telescopic appearance of the sun, 82 ; 46, on the telescopic appearance of Saturn, Jupiter, Mars, and Venus, 85 ; 47, (by Bishop Brinkley) on the changes of the earth's surface, as proved by geological discoveries, 87 ; 48, on gravitation, 91 ; 49, referring to Notes 52 and 54 ; 50, on the attraction of the planets, 94 ; 51, description of cut representing the earth's orbit, and observations on the orbits of planets, 97 ; 52 (by Bishop Brinkley), on attraction, 100 ; 53, description of cut representing the comet of 1811, and observations on comets, 104 ; 54 (by Bishop Brinkley), on the solar system, 106.

CHAP. XXIII.—OF THE PERSONALITY OF THE DEITY.

Not the object of our senses, 109 ; contrivance proves personality, 111 ; misapplication of laws, 113 ; mechanism, 114 ; second causes, 115 ; of generation as a principle, 117 ; atheistic suppositions, 118 ; Buffon's organic molecules, 120 ; appetencies, 122 ; analogies by which they are supported, 125 ; camel's bunch, *ib.* ; crane's thighs, *ib.* ; pelican's pouch, *ib.* ; analogy strained, 128 ; solutions contradicted, *ib.* ; by ligaments—valves, *ib.* ; by senses of animals, 129 ; by the parts without motion, *ib.* ; by plants, *ib.*

Note 55, on the sceptical argument of the formation of organs from *conatus* or appetency, 123 ; 56, on hermaphrodites, 124 ; 57, argument against the doctrine of appetencies, 127.

CHAP. XXIV.—OF THE NATURAL ATTRIBUTES OF THE DEITY.

Omnipotence, 132; omniscience, *ib.*; omnipresence, 133; eternity, 135; self-existence, *ib.*; necessary existence, 136; spirituality, *ib.*

Note 58, on the terms *infinite* and *omnipotence*, 133; 59, on ubiquity, 134; 60, explanation of the terms *self-existent* and *self-created*, 135; 61, explanation of the term *necessary*, 136.

CHAP. XXV.—THE UNITY OF THE DEITY.

From the laws of attraction, and the presence of light among the heavenly bodies, 137; from the laws of nature upon our globe, 139; resemblance of animals, 140; fish, *ib.*; insects, 141.

Note 62, argument for the unity of the Deity drawn from astronomical science, 137; 63, on the law which regulates the distances of the planets, 139; 64, referring to Paley's argument for the unity of the Deity, 141; 65, referring to Addison's belief in ghosts and witchcraft, 142.

CHAP. XXVI.—GOODNESS OF THE DEITY.

From the parts and faculties of animals, 143; the actual happiness of young animals, 144; of winged insects, *ib.*; of aphides, of fish, 144, 145; i. Prop. of old age, 146; of different animal habits, *ib.*; prepollency of happiness, 148; causes of not observing it, *ib.*; quotation, 150; apparent exceptions, 151; venomous animals, 152; animals of prey, 154;—ii. Prop. taste, 162; adaptation of senses, 164; property, origin of, 166; physical evils of imperfection, 169; of finiteness, *ib.*; of bodily pain, 170; of mortal diseases, 171; of death, 173; civil evils of population, 175; of distinctions, 177; of wealth, *ib.*; of idleness, 180; objections from chance answered, *ib.*; must be chance in the midst of design, *ib.*; ignorance of observance, 181; advantages of chance, 182; disease, 183; seasons, 184; station, *ib.*; acquirability, 185; sensible interposition, 186; probation, 189.

Note 66, on length of life as marked by succession of ideas, 145; 67, on Paley's opinions with respect to physical and moral evil, 149; 68, on the balance of good and evil, 154; 69, on the addition of pleasure to animal sensations, 160; 70, on the numerous sources of gratification, 162; 71, remarks on Paley's observations on general laws, 167; 72, on the circumstances under which Chapter xxvi. was written, 171; 73, referring to Note 71, 174; 74, on contentment under necessary sufferings, 175; 75, referring to Note, p. 55 of vol. ii., respecting chance, 182; 76, one branch of the sceptical argument that the destruction of one being is beneficial to another, answered by the doctrine of a future state, 183; 77, referring to former Note, on the benefits of apparent evils, 184; 78, on the obscurity which hangs over the subject of a future state, 188; 79, on circumstances which seem to show the interposition of Providence, 197; 80, on the universal power and pervading skill of the Deity, 201.

CHAP. XXVII.—CONCLUSION.

Natural religion prepares the way for revelation, 196.

ILLUSTRATIVE WOODCUTS.—VOL. III.

---

1. Ovipositors of insects, 30
2. Proboscis of the bee dissected, 33
3. Mouths of beetle and bees dissected, 36
4. Silkworm, 39
5. Garden snail, 46
6. Prickly oyster, 47
7. Cock's-comb oyster, 47
8. Venus's heart cockle, 48
9. Poppy, 54
10. Cuscuta Europæa, 65
11. Autumnal crocus, 67
12. Pitcher-plant, 69
13. Telescopic view of the Sun, 83
14. Telescopic view of Saturn, Jupiter, Mars, and Venus, 85
15. Representation of the earth's orbit, 97
16. View of the comet of 1811, 104

NATURAL THEOLOGY.

CHAPTER XVII.

THE RELATION OF ANIMATED BODIES TO INANIMATE NATURE.

We have already considered *relation*, and under different views; but it was the relation of parts to parts, of the parts of an animal to other parts of the same animal, or of another individual of the same species.

But the bodies of animals hold, in their constitution and properties, a close and important relation to natures altogether external to their own: to inanimate substances, and to the specific qualities of these; *e. g.*, *they hold a strict relation to the* ELEMENTS *by which they are surrounded.*

I. Can it be doubted, whether the *wings of birds* bear a relation to air, and the *fins of fish* to water? They are instruments of motion severally suited to the properties of the medium in which the motion is to be performed; which properties are different. Was not this difference contemplated when the instruments were differently constituted?

II. The structure of the animal *ear* depends for its use not simply upon being surrounded by a fluid, but upon the specific nature of that fluid. Every fluid would not serve: its particles must repel one another; it must form an elastic medium: for it is by the successive pulses of *such* a medium that the undulations excited by the surrounding body are carried to the organ; that a communication is formed between the object and the sense; which must be done, before the internal machinery of the ear, subtile as it is, can act at all.

III. The *organs* of voice and respiration are, no less than the ear, indebted, for the success of their operation, to the peculiar qualities of the fluid in which the animal is immersed. They, therefore, as well as the ear, are constituted upon the supposition of such a fluid, *i. e.*, of a fluid with such particular properties, being always present. Change the properties of the fluid, and the organ cannot act; change the organ, and the properties of the fluid would be lost. The structure, therefore, of our organs, and the properties of our atmosphere, are made for one another. Nor does it alter the relation, whether you allege the organ to be made for the element (which seems the most natural way of considering it), or the element as prepared for the organ.

IV. But there is another fluid with which we have to do; with properties of its own; with laws of acting, and of being acted upon, totally different from those of air and water: and that is *light*. To this new, this singular element—to qualities perfectly peculiar, perfectly distinct and remote from the qualities of any other substance with which we are acquainted—an organ is adapted, an instrument is correctly adjusted, not less peculiar amongst the parts of the body, not less singular in its form and in the substance of which it is composed, not less remote from the materials, the model, and the analogy of any other part of the animal frame, than the element to which it relates is specific amidst the substances with which we converse. If this does not prove appropriation, I desire to know what would prove it.

Yet the element of light and the organ of vision, however related in their office and use, have no connexion whatever in their original. The action of rays of light upon the surfaces of animals has no tendency to breed eyes in their heads. The sun might shine for ever upon living bodies, without the smallest approach towards producing the sense of sight. On the other hand also, the animal eye does *not* generate or emit light.

V. Throughout the universe there is a wonderful *proportioning* of one thing to another. The size of animals, the human animal especially, when considered

with respect to other animals, or to the plants which grow around him, is such as a regard to his conveniency would have pointed out. A giant or a pigmy could not have milked goats, reaped corn, or mowed grass; we may add, could not have rode a horse, trained a vine, shorn a sheep, with the same bodily ease as we do, if at all. A pigmy would have been lost amongst rushes, or carried off by birds of prey.[1]

It may be mentioned, likewise, that the model and the materials of the human body being what they are, a much greater bulk would have broken down by its own weight. The persons of men who much exceed the ordinary stature betray this tendency.

VI. Again (and which includes a vast variety of particulars, and those of the greatest importance), how close is the *suitableness* of the earth and sea to their several inhabitants; and of these inhabitants to the places of their appointed residence!

Take the *earth* as it is; and consider the correspondency of the powers of its inhabitants with the properties and condition of the soil which they tread. Take the inhabitants as they are; and consider the substances which the earth yields for their use. They can scratch its surface, and its surface supplies all which they want. This is the length of their faculties; and such is the constitution of the globe, and their own, that this is sufficient for all their occasions.

When we pass from the earth to the *sea*, from land to water, we pass through a great change: but an adequate change accompanies us of animal forms and functions, of animal capacities and wants; so that *correspondency* remains. The earth in its nature is very different from the sea, and the sea from the earth, but one accords with its inhabitants as exactly as the other.

VII. The last relation of this kind which I shall mention is that of *sleep* to *night;* and it appears to me to be a relation which was expressly intended. Two points are manifest: first, that the animal frame requires sleep; secondly, that night brings with it a silence and

[1] See the Appendix, on the bones of huge animals.

a cessation of activity which allows of sleep being taken without interruption and without loss. Animal existence is made up of action and slumber; nature has provided a season for each. An animal which stood not in need of rest would always live in daylight. An animal which, though made for action, and delighting in action, must have its strength repaired by sleep, meets, by its constitution, the returns of day and night. In the human species, for instance, were the bustle, the labour, the motion of life upheld by the constant presence of light, sleep could not be enjoyed without being disturbed by noise, and without expense of that time which the eagerness of private interest would not contentedly resign. It is happy, therefore, for this part of the creation, I mean that it is conformable to the frame and wants of their constitution, that nature, by the very disposition of her elements, has commanded, as it were, and imposed upon them, at moderate intervals, a general intermission of their toils, their occupations, and pursuits.

But it is not for man, either solely or principally, that night is made. Inferior but less perverted natures taste its solace, and expect its return with greater exactness and advantage than he does. I have often observed, and never observed but to admire, the satisfaction, no less than the regularity, with which the greatest part of the irrational world yield to this soft necessity, this grateful vicissitude; how comfortably the birds of the air, for example, address themselves to the repose of the evening, with what alertness they resume the activity of the day.

Nor does it disturb our argument to confess that certain species of animals are in motion during the night and at rest in the day. With respect even to them, it is still true that there is a change of condition in the animal, and an external change corresponding with it. There is still the relation, though inverted. The fact is that the repose of other animals sets these at liberty, and invites them to their food or their sport.

If the relation of *sleep* to *night*, and, in some instances, its converse, be real, we cannot reflect without amaze-

ment upon the extent to which it carries us. Day and night are things close to us; the change applies immediately to our sensations; of all the phenomena of nature, it is the most obvious and the most familiar to our experience; but, in its cause, it belongs to the great motions which are passing in the heavens. Whilst the earth glides round her axle she ministers to the alternate necessities of the animals dwelling upon her surface, at the same time that she obeys the influence of those attractions which regulate the order of many thousand worlds. The relation, therefore, of sleep to night is the relation of the inhabitants of the earth to the rotation of their globe; probably it is more, it is a relation to the system of which that globe is a part; and, still further, to the congregation of systems of which theirs is only one. If this account be true, it connects the meanest individual with the universe itself,—a chicken roosting upon its perch with the spheres revolving in the firmament.[2]

[2] Nothing is more true than that the strength of the bones and the power of the muscles stand in intimate relation with the weight of the body, that is also, in relation with the attraction of the globe itself. It is no less certain that many of the living properties of animals, the condition of the nervous system, and the alternation of exertion and repose in the muscular system, are related to the change of day and night, or to the revolving of our planet upon its axis. In man we may see a slight deviation in his habits and occupations from this correspondence with the succession of light and darkness; yet he enjoys a return of energy and elasticity of spirits, which is followed by weariness and exhaustion; and health will not long continue without yielding to the alternate condition of activity and repose. In nothing do we see the benevolence of the Creator more than in the continued gratification consequent on this arrangement alone, and more especially in the brutes. It is not a mere effect of light and the freshness of the morning which produces the almost universal animation and activity of that time of day; for to many animals the light of day is the signal to seek repose; and that it is not the mere necessity which brings animals abroad at night, in order to feed secluded, or escape their enemies, we know from this, that their organs are adapted to the obscurer light, and not their organs only, but

VIII. But if any one object to our representation, that the succession of day and night, or the rotation of

their propensities; for they are as full of activity and enjoyment as the things of day. The history of pulmonary and other complaints indicates a curious connexion between the functions of the body and the revolution of time or alternations of day and night.

But the most remarkable accommodation of the economy of animals, and of the property of life itself in them, regards the changes of the year rather than the diurnal change. How much this prevails in the vegetable world we have only to look around us fully to comprehend. With the diminution of heat vegetation is nipped, the ova of insects locked up, and the food of many animals withdrawn. Some animals could not be protected by an instinct of migration, being without the means of passage: the bat could not fly away with the swallow, nor the hedgehog and dormouse travel with the deer. To sustain the animal heat against the low temperature of the surrounding atmosphere requires a vigorous circulation of the blood and a plentiful and uninterrupted supply of food. Many animals must therefore have died during the winter had not nature supplied a means of their continuance in life beyond the ingenuity of man to conceive. The warmth of their clothing, and the instincts to build themselves a warm habitation, which we should almost say were the exercise of ingenuity, are insufficient. To sustain life they must hold it by a new tenure. Accordingly the necessity for food is removed; the activity of the circulation is diminished remarkably; a torpor seizes upon every living faculty, and they fall into what seems a long sleep. Yet it is not sleep, but a new condition of existence, in which life is preserved without the necessity for food, and when all the functions of the system are let down to a lower state of activity. And justly, therefore, it has been said that in these things we trace the benevolence of the Creator, "who did not cast his living creatures into the world to prosper or perish as they might find it suited to them or not, but fitted together with the nicest skill the world and the constitution which he gave to its inhabitants; so fashioning it, that light and darkness, sun and air, moist and dry, should become their ministers and benefactors, the unwearied and unfailing causes of their well-being."—*Whewell's Bridgewater Treatise.*

the earth upon which it depends, is not resolvable into central attraction, we will refer him to that which certainly is,—to the change of the seasons. Now the constitution of animals susceptible of torpor bears a relation to winter similar to that which sleep bears to night. Against not only the cold, but the want of food, which the approach of winter induces, the Preserver of the world has provided in many animals by migration, in many others by torpor. As one example out of a thousand, the bat, if it did not sleep through the winter, must have starved ; as the moths and flying insects upon which it feeds disappear. But the transition from summer to winter carries us into the very midst of physical astronomy, that is to say, into the midst of those laws which govern the solar system at least, and probably all the heavenly bodies.

CHAPTER XVIII.

INSTINCTS.

THE order may not be very obvious by which I place *instincts* next to relations. But I consider them as a species of relation. They contribute, along with the animal organization, to a joint effect, in which view they are related to that organization. In many cases they refer from one animal to another animal; and, when this is the case, become strictly relations in a second point of view.

An INSTINCT is a propensity prior to experience and independent of instruction. We contend that it is by *instinct* that the sexes of animals seek each other; that animals cherish their offspring; that the young quadruped is directed to the teat of its dam; that birds build their nests and brood with so much patience upon their eggs; that insects which do not sit upon their eggs deposit them in those particular situations in which the young when hatched find their appropriate food; that it is instinct which carries the salmon, and some other fish, out of the sea into rivers, for the purpose of shedding their spawn in fresh water.

We may select out of *this* catalogue the incubation of eggs. I entertain no doubt but that a couple of sparrows hatched in an oven, and kept separate from the rest of their species, would proceed as other sparrows do in every office which related to the production and preservation of their brood. Assuming this fact,[3] the

[3] There can be very little doubt of this assumption being according to the fact. Nevertheless, as the experiment has probably not been actually made, there is no harm in mentioning one or two examples of the same import, and which

thing is inexplicable upon any other hypothesis than that of an instinct impressed upon the constitution of the animal. For, first, what should induce the female bird to prepare a nest before she lays her eggs? It is in vain to suppose her to be possessed of the faculty of reasoning; for no reasoning will reach the case. The fulness or distension which she might feel in a particular part of the body, from the growth and solidity of the egg within her, could not possibly inform her that she was about to produce something which, when produced, was to be preserved and taken care of. Prior to experience there was nothing to lead to this inference, or to this suspicion. The analogy was *all* against it; for, in every other instance, what issued from the body was cast out and rejected.

But, secondly, let us suppose the egg to be produced into day; how should birds know that their eggs contain their young? There is nothing either in the aspect or in the internal composition of an egg which could lead even the most daring imagination to conjecture that

are ascertained by repeated observation. When caterpillars bred upon a tree are shaken off and fall for the first time upon the ground, they immediately regain the tree by crawling up as quick as they can. Again—it is a very general law of insects, that the grub feeds upon a food which the parent does not eat, and yet the latter makes provision for the grub. Thus the solitary wasp deposits its eggs, each in a hole, and then collects a certain number of green worms, which she rolls up and deposits in the same hole, over the egg. When the grub is hatched, it feeds upon these worms until transformed into a young wasp. And here two things are remarkable: first, the wasp itself never feeds upon the worm, or indeed on any animal food; and next, M. Réaumur found that she provides just enough of the worms to sustain the grub till it becomes a fly, and changes its food. Our author dwells afterwards upon the application to the argument of the fact that the parent insect never sees its young. The architecture of bees affords perhaps the most striking illustration; for those which have been taken without ever having any communication with the former race, build precisely in the accustomed manner. See the next note.

it was hereafter to turn out from under its shell a living perfect bird. The form of the egg bears not the rudiments of a resemblance to that of the bird. Inspecting its contents, we find still less reason, if possible, to look for the result which actually takes place. If we should go so far as, from the appearance of order and distinction in the disposition of the liquid substances which we noticed in the egg, to guess that it might be designed for the abode and nutriment of an animal (which would be a very bold hypothesis), we should expect a tadpole dabbling in the slime, much more than a dry, winged, feathered creature, a compound of parts and properties impossible to be used in a state of confinement in the egg, and bearing no conceivable relation, either in quality or material, to anything observed in it. From the white of an egg, would any one look for the feather of a goldfinch? or expect from a simple uniform mucilage the most complicated of all machines, the most diversified of all collections of substances? Nor would the process of incubation, for some time at least, lead us to suspect the event. Who that saw red streaks shooting in the fine membrane which divides the white from the yolk would suppose that these were about to become bones and limbs? Who that espied two discoloured points first making their appearance in the cicatrix, would have had the courage to predict that these points were to grow into the heart and head of a bird? It is difficult to strip the mind of its experience. It is difficult to resuscitate surprise when familiarity has once laid the sentiment asleep. But could we forget all that we know, and which our sparrows never knew, about oviparous generation — could we divest ourselves of every information but what we derived from reasoning upon the appearances or quality discovered in the objects presented to us—I am convinced that Harlequin coming out of an egg upon the stage is not more astonishing to a child than the hatching of a chicken both would be, and ought to be, to a philosopher.[4]

[4] The manner in which the chicken breaks the egg is one of the most wonderful operations of instinct, and is a process

But admit the sparrow by some means to know that within that egg was concealed the principle of a future bird: from what chemist was she to learn that *warmth* was necessary to bring it to maturity, or that the degree of warmth imparted by the temperature of her own body was the degree required?

To suppose, therefore, that the female bird acts in this process from a sagacity and reason of her own, is to suppose her to arrive at conclusions which there are no premises to justify. If our sparrow, sitting upon her eggs, expect young sparrows to come out of them, she forms, I will venture to say, a wild and extravagant expectation, in opposition to present appearances and to probability. She must have penetrated into the order of nature farther than any faculties of ours will carry us; and it hath been well observed, that this deep sagacity, if it be sagacity, subsists in conjunction with great stupidity, even in relation to the same subject. "A chemical operation," says Addison, "could not be followed with greater art or diligence than is seen in hatching a chicken; yet is the process carried on without the least glimmering of thought or common sense. The hen will mistake a piece of chalk for an egg—is insensible of the increase or diminution of their number—does not distinguish between her own and those of another species

marked by the uniformity of instincts. For as all bees build alike with respect to the size of the cell and the angles at which its planes are inclined, so M. Réaumur found that all chickens chip the shell in the same direction, from left to right; and that the circle in which they chip invariably cuts the egg at right angles to its transverse axis, and not obliquely. The instrument which the chicken employs is a small protuberance on its upper mandible, called the *bill-scale*, which has no other use, and accordingly drops off soon after the bird is hatched. If any one should consider this as a different operation in kind from those usually ascribed to instinct in animals that are formed, a little reflection will probably show him the impossibility of drawing any such line of distinction. See the Dissertation on Instinct, Appendix.

—is frightened when her supposititious breed of ducklings take the water."

But it will be said, that what reason could not do for the bird, observation, or instruction, or tradition might. Now if it be true that a couple of sparrows, brought up from the first in a state of separation from all other birds, would build their nest, and brood upon their eggs, then there is an end of this solution. What can be the traditionary knowledge of a chicken hatched in an oven?

Of young birds taken in their nests, a few species breed when kept in cages; and they which do so build their nests nearly in the same manner as in the wild state, and sit upon their eggs. This is sufficient to prove an instinct without having recourse to experiments upon birds hatched by artificial heat, and deprived from their birth of all communication with their species; for we can hardly bring ourselves to believe that the parent bird informed her unfledged pupil of the history of her gestation, her timely preparation of a nest, her exclusion of the eggs, her long incubation, and of the joyful eruption at last of her expected offspring: all which the bird in the cage must have learnt in her infancy if we resolve her conduct into *institution*.

Unless we will rather suppose that she remembers her own escape from the egg—had attentively observed the conformation of the nest in which she was nurtured—and had treasured up her remarks for future imitation; which is not only extremely improbable, (for who that sees a brood of callow birds in their nest can believe that they are taking a plan of their habitation?) but leaves unaccounted for one principal part of the difficulty, "the preparation of the nest before the laying of the egg." This she could not gain from observation in her infancy.

It is remarkable also, that the hen sits upon eggs which she has laid without any communication with the male, and which are therefore necessarily unfruitful. That secret she is not let into. Yet if incubation had been a subject of instruction or of tradition, it should seem that this distinction would have formed part of the lesson: whereas the instinct of nature is calculated for a

state of nature—the exception here alluded to taking place chiefly, if not solely, amongst domesticated fowls, in which nature is forced out of her course.

There is another case of oviparous economy, which is still less likely to be the effect of education than it is even in birds, namely, that of *moths* and *butterflies*, which deposit their eggs in the precise substance—that of a cabbage for example—from which, not the butterfly herself, but the caterpillar which is to issue from her egg, draws its appropriate food. The butterfly cannot taste the cabbage: cabbage is no food for her; yet in the cabbage, not by chance, but studiously and electively, she lays her eggs. There are, amongst many other kinds, the willow-caterpillar and the cabbage-caterpillar; but we never find upon a willow the caterpillar which eats the cabbage, nor the converse. This choice, as appears to me, cannot in the butterfly proceed from instruction. She had no teacher in her caterpillar state. She never knew her parent. I do not see, therefore, how knowledge acquired by experience, if it ever were such, could be transmitted from one generation to another. There is no opportunity either for instruction or imitation. The parent race is gone before the new brood is hatched. And if it be original reasoning in the butterfly, it is profound reasoning indeed. She must remember her caterpillar state, its tastes and habits, of which memory she shows no signs whatever. She must conclude from analogy (for here her recollection cannot serve her), that the little round body which drops from her abdomen will at a future period produce a living creature, not like herself, but like the caterpillar which she remembers herself once to have been. Under the influence of these reflections, she goes about to make provision for an order of things which she concludes will some time or other take place. And it is to be observed, that not a few out of many, but that all butterflies argue thus; all draw this conclusion; all act upon it.

But suppose the address, and the selection, and the plan, which we perceive in the preparations which many irrational animals make for their young, to be

traced to some probable origin, still there is left to be accounted for that which is the source and foundation of these phenomena, that which sets the whole at work, the στοργη, the parental affection, which I contend to be inexplicable upon any other hypothesis than that of instinct.

For we shall hardly, I imagine, in brutes, refer their conduct towards their offspring to a sense of duty or of decency, a care of reputation, a compliance with public manners, with public laws, or with rules of life built upon a long experience of their utility. And all attempts to account for the parental affection from association, I think, fail. With what is it associated? Most immediately with the throes of parturition, that is, with pain, and terror, and disease. The more remote, but not less strong association, that which depends upon analogy, is all against it. Everything else which proceeds from the body is cast away and rejected. In birds is it the egg which the hen loves? or is it the expectation which she cherishes of a future progeny that keeps her upon her nest? What cause has she to expect delight from her progeny? Can any rational answer be given to the question, why, prior to experience, the brooding hen should look for pleasure from her chickens? It does not, I think, appear that the cuckoo ever knows her young; yet, in her way, she is as careful in making provision for them as any other bird. She does not leave her egg in every hole.

The salmon suffers no surmountable obstacle to oppose her progress up the stream of fresh rivers. And what does she do there? She sheds a spawn, which she immediately quits in order to return to the sea; and this issue of her body she never afterwards recognizes in any shape whatever. Where shall we find a motive for her efforts and her perseverance? Shall we seek it in argumentation or in instinct? The violet crab of Jamaica performs a fatiguing march of some months' continuance from the mountains to the sea-side. When she reaches the coast, she casts her spawn into the open sea, and sets out upon her return home.

Moths and butterflies, as hath already been observed, seek out for their eggs those precise situations and substances in which the offspring caterpillar will find its appropriate food. That dear caterpillar the parent butterfly must never see. There are no experiments to prove that she would retain any knowledge of it if she did. How shall we account for her conduct? I do not mean for her art and judgment in selecting and securing a maintenance for her young, but for the impulse upon which she acts. What should induce her to exert any art, or judgment, or choice, about the matter? The undisclosed grub, the animal which she is destined not to know, can hardly be the object of a particular affection, if we deny the influence of instinct. There is nothing, therefore, left to her, but that of which her nature seems incapable, an abstract anxiety for the general preservation of the species—a kind of patriotism—a solicitude lest the butterfly race should cease from the creation.

Lastly, the principle of association will not explain the discontinuance of the affection when the young animal is grown up. Association operating in its usual way would rather produce a contrary effect. The object would become more necessary by habits of society; whereas birds and beasts, after a certain time, banish their offspring, disown their acquaintance, seem to have even no knowledge of the objects which so lately engrossed the attention of their minds and occupied the industry and labour of their bodies. This change, in different animals, takes place at different distances of time from the birth; but the time always corresponds with the ability of the young animal to maintain itself, never anticipates it. In the sparrow tribe, when it is perceived that the young brood can fly and shift for themselves, then the parents forsake them for ever; and, though they continue to live together, pay them no more attention than they do to other birds in the same flock.* I believe the same thing is true of all gregarious quadrupeds.[5]

* Goldsmith's Natural History, vol. iv. p. 244.

[5] In the natural and instinctive feelings of man, as con-

In this part of the case the variety of resources, expedients, and materials which animals of the same species are said to have recourse to under different circumstances, and when differently supplied, makes nothing against the doctrine of instincts. The thing which we want to account for is the propensity. The propensity being there, it is probable enough that it may put the animal upon different actions according to different exigencies. And this adaptation of resources may look like the effect of art and consideration rather than of instinct; but still the propensity is instinctive. For instance, suppose what is related of the woodpecker to be true, that in Europe she deposits her eggs in cavities which she scoops out in the trunks of soft or decayed trees, and in which cavities the eggs lie concealed from the eye, and in some sort safe from the hand of man, but that, in the forests of Guinea and the Brazils, which man seldom frequents, the same bird hangs her nest on the twigs of tall trees, thereby placing them out of the reach of *monkeys* and *snakes*—*i. e.*, that in each situation she prepares against the danger which she has most occasion to apprehend. Suppose, I say, this to be true, and to be alleged, on the part of the bird that builds these nests, as evidence of a reasoning and distinguishing precaution: still the question returns, whence the propensity to build at all?

Nor does parental affection accompany generation by any universal law of animal organization, if such a thing were intelligible. Some animals cherish their progeny with the most ardent fondness, and the most assiduous

tradistinguished from those which have been modified by reason, something of the same kind may be observed. The mutual relation of protection and dependence, produced by power and weakness, is of this description. A helpless infant excites much stronger sympathy in the mother than the child that can shift for itself; and hence the partiality, accompanied by blindness to defects, which most parents entertain towards children whose natural deficiency, whether bodily or mental, throws them on their care long after the season of infancy.

attention; others entirely neglect them; and this distinction always meets the constitution of the young animal with respect to its wants and capacities. In many, the parental care extends to the young animal; in others, as in all oviparous fish, it is confined to the egg, and even as to that, to the disposal of it in its proper element. Also, as there is generation without parental affection, so is there parental instinct, or what exactly resembles it, without generation. In the bee tribe, the grub is nurtured neither by the father nor the mother, but by the neutral bee. Probably the case is the same with ants.

I am not ignorant of the theory which resolves instinct into sensation, which asserts that what appears to have a view and relation to the future, is the result only of the present disposition of the animal's body, and of pleasure or pain experienced *at the time*. Thus the incubation of eggs is accounted for by the pleasure which the bird is supposed to receive from the pressure of the smooth convex surface of the shells against the abdomen, or by the relief which the mild temperature of the egg may afford to the heat of the lower part of the body, which is observed at this time to be increased beyond its usual state. This present gratification is the only motive with the hen for sitting upon her nest; the hatching of the chickens is, with respect to her, an accidental consequence. The affection of viviparous animals for their young is in like manner solved by the relief, and perhaps the pleasure, which they perceive from giving suck. The young animal's seeking, in so many instances, the teat of its dam, is explained from its sense of smell, which is attracted by the odour of milk. The salmon's urging its way up the stream of fresh-water rivers is attributed to some gratification or refreshment which, in this particular state of the fish's body, she receives from the change of element. Now of this theory it may be said,—

First, that of the cases which require solution, there are few to which it can be applied with tolerable probability; that there are none to which it can be applied

without strong objections, furnished by the circumstances of the case. The attention of the cow to its calf, and of the ewe to its lamb, appear to be prior to their sucking. The attraction of the calf or lamb to the teat of the dam, is not explained by simply referring it to the sense of smell. What made the scent of milk so agreeable to the lamb that it should follow it up with its nose, or seek with its mouth the place from which it proceeded? No observation, no experience, no argument could teach the new-dropped animal that the substance from which the scent issued was the material of its food. It had never tasted milk before its birth. None of the animals which are not designed for that nourishment ever offer to suck, or to seek out any such food. What is the conclusion, but that the sugescent parts of animals are fitted for their use, and the knowledge of that use put into them?

We assert, secondly, that, even as to the cases in which the hypothesis has the fairest claim to consideration, it does not at all lessen the force of the argument for intention and design. The doctrine of instinct is that of appetencies, *superadded* to the constitution of an animal, for the effectuating of a purpose beneficial to the species. The above-stated solution would derive these appetencies from organization; but then this organization is not less specifically, not less precisely, and, therefore, not less evidently adapted to the same ends, than the appetencies themselves would be upon the old hypothesis. In this way of considering the subject, sensation supplies the place of foresight: but this is the effect of contrivance on the part of the Creator. Let it be allowed, for example, that the hen is induced to brood upon her eggs by the enjoyment or relief which, in the heated state of her abdomen, she experiences from the pressure of round smooth surfaces, or from the application of a temperate warmth. How comes this extraordinary heat or itching, or call it what you will, which you suppose to be the cause of the bird's inclination, to be felt just at the time when the inclination itself is wanted: when it tallies so exactly with the internal

constitution of the egg, and with the help which that constitution requires in order to bring it to maturity? In my opinion, this solution, if it be accepted as to the fact, ought to increase, rather than otherwise, our admiration of the contrivance.[6] A gardener lighting up his

[6] Whether we regard the argument of existence, or of attributes, the truth here glanced at is of extreme importance, and it pervades the whole of Natural Theology. It will be more fully illustrated in the Appendix, and in the notes to the subsequent chapters. When sceptics think they have destroyed one reason for believing in the skill or in the goodness of the Deity, by an explanation of the means used for producing some given effect, they only remove our admiration and our gratitude from one point to another, and often augment both the one and the other. Suppose it were discovered, contrary to all probability, that the bee makes the angles of 109° 28′ and 70° 32′ by means of some bodily conformation which secures this result,—some form of its own parts answering to those angles, if such a thing can be conceived; the wonder is only removed from the working of the insect without a tool to its using a tool provided for it by the intelligence which had solved the problem of maxima and minima, whence this conformation is a corollary. Again,—the loss of one sense, as the sight, quickens our perceptions through the organs of those senses which remain,—as touch and hearing. It is most probable that this effect is produced by the influence of habit, and has no direct connexion with the loss sustained. But habit might have had no such effect, and it might have blunted instead of sharpening; its effect tends to lessen the evil of the loss sustained; and it produces this advantage just as much as if the compensation had been the direct and immediate consequence of that loss. We are not here arguing the question of evil: that will be treated of hereafter, and it is common to both suppositions; both to the case of immediate and of mediate compensation. Again, —suppose, in generalizing, we could resolve all intellectual phenomena into some one principle, as association,—all moral into some other, as habit,—all physical into some third, as gravitation;—nay, suppose the doctrines of some materialists to prevail, and that all mental and all physical phenomena were resolvable into the operations of some sub-

stoves, just when he wants to force his fruit, and when his trees require the heat, gives not a more certain evidence of design. So again; when a male and female sparrow come together, they do not meet to confer upon the expediency of perpetuating their species. As an abstract proposition, they care not the value of a barley-corn whether the species be perpetuated, or not: they follow their sensations, and all those consequences ensue, which the wisest counsels could have dictated, which the most solicitous care of futurity, which the most anxious concern for the sparrow-world, could have produced. But how do these consequences ensue? The sensations, and the constitution upon which they depend, are as manifestly directed to the purpose which we see fulfilled by them; and the train of intermediate effects as manifestly laid and planned with a view to that purpose: that is to say, design is as completely evinced by the phenomena, as it would be, even if we suppose the operations to begin or to be carried on, from what some will allow to be alone properly called instincts, that is, from desires directed to a future end, and having no accomplishment or gratification distinct from the attainment of that end.

In a word: I should say to the patrons of this opinion, Be it so; be it that those actions of animals which we refer to instinct are not gone about with any view to their consequences, but that they are attended in the animal with a present gratification, and are pursued for the sake of that gratification alone; what does all this prove, but that the *prospection*, which must be somewhere, is not in the animal, but in the Creator?

In treating of the parental affection in brutes, our business lies rather with the origin of the principle, than

tile fluid,—this would surely not weaken the arguments for the unity of the Deity, if indeed it did not rather strengthen them; it would in no degree detract from our conviction of his skill, nor even of the variety of its operations; and it would leave the argument as to goodness exactly where it stood before.—See Appendix, Dissertation upon Evil.

with the effects and expressions of it. Writers recount these with pleasure and admiration. The conduct of many kinds of animals towards their young has escaped no observer, no historian of nature. "How will they caress them," says Derham, "with their affectionate notes; lull and quiet them with their tender parental voice; put food into their mouths; cherish and keep them warm; teach them to pick, and eat, and gather food for themselves; and, in a word, perform the part of so many nurses, deputed by the Sovereign Lord and Preserver of the world to help such young and shiftless creatures!" Neither ought it, under this head, to be forgotten, how much the instinct *costs* the animal which feels it; how much a bird, for example, gives up by sitting upon her nest; how repugnant it is to her organization, her habits and her pleasures. An animal, formed for liberty, submits to confinement, in the very season when every thing invites her abroad: what is more, an animal delighting in motion, made for motion, all whose motions are so easy, and so free, hardly a moment, at other times, at rest, is, for many hours of many days together, fixed to her nest, as close as if her limbs were tied down by pins and wires. For my part, I never see a bird in that situation but I recognize an invisible hand, detaining the contented prisoner from her fields and groves, for the purpose, as the event proves, the most worthy of the sacrifice, the most important, the most beneficial.

But the loss of liberty is not the whole of what the procreant bird suffers. Harvey tells us that he has often found the female wasted to skin and bone by sitting upon her eggs.

One observation more, and I will dismiss the subject. The *pairing* of birds, and the *non-pairing* of beasts, forms a distinction between the two classes, which shows that the conjugal instinct is modified with a reference to utility founded on the condition of the offspring. In quadrupeds, the young animal draws its nutriment from the body of the dam. The male parent neither does

nor can contribute any part to its sustentation. In the winged race, the young bird is supplied by an importation of food, to procure and bring home which, in a sufficient quantity for the demand of a numerous brood, requires the industry of both parents. In this difference, we see a reason for the vagrant instinct of the quadruped, and for the faithful love of the feathered mate.

CHAPTER XIX.

OF INSECTS.

We are not writing a system of natural history; therefore we have not attended to the classes into which the subjects of that science are distributed. What we had to observe concerning different species of animals, fell easily, for the most part, within the divisions which the course of our argument led us to adopt. There remain, however, some remarks, upon the *insect* tribe, which could not properly be introduced under any of these heads; and which therefore we have collected into a chapter by themselves.

The structure, and the use of the parts, of insects, are less understood than that of quadrupeds and birds, not only by reason of their minuteness, or the minuteness of their parts (for that minuteness we can, in some measure, follow with glasses), but also by reason of the remoteness of their manners and modes of life from those of larger animals. For instance: Insects, under all their varieties of form, are endowed with *antennæ*,[7] which is the name

[7] The most scientific entomologists consider the antennæ of insects to be organs of hearing; this is the opinion of those who have minutely examined their structure; whereas very many entomologists contend that the antennæ are organs of feeling, observing that many insects are constantly touching surrounding objects with them, such as the bee tribe, ichneumonidæ, &c. The argument used against the latter opinion is, that although many insects do undoubtedly touch surrounding objects with their antennæ, yet many scrupulously avoid so doing, such as the butterfly and moth tribe, the Lamellicorn beetles, &c. When, however, we are asked the question, what is hearing as distinguished from feeling, we find it difficult to draw any line. Are they not

given to those long feelers that rise from each side of the head: but to what common use or want of the insect kind a provision so universal is subservient has not yet been ascertained; and it has not been ascertained, because it admits not of a clear, or very probable, comparison with any organs which we possess ourselves, or with the organs of animals which resemble ourselves in their functions and faculties, or with which we are better acquainted than we are with insects. We want a ground of analogy. This difficulty stands in our way as to some particulars in the insect constitution, which we might wish to be acquainted with. Nevertheless, there are many contrivances in the bodies of insects, neither dubious in their use, nor obscure in their structure, and most properly mechanical. These form parts of *our* argument.

I. The *elytra*, or scaly wings of the genus of scarabæus or beetle, furnish an example of this kind. The true wing of the animal is a light, transparent membrane, finer than the finest gauze, and not unlike it. It is also, when expanded, in proportion to the size of the animal, very large. In order to protect this delicate structure, and, perhaps, also to preserve it in a due state of suppleness and humidity, a strong, hard case is given to it in the shape of the horny wing which we call the elytron. When the animal is at rest, the gauze wings lie folded up under this impenetrable shield. When the beetle prepares for flying, he raises the integument, and spreads out his thin membrane to the air. And it cannot be observed without admiration, what a tissue of cordage, *i. e.*, of muscular tendons, must run in various and complicated, but determinate directions, along this fine surface, in order to enable the animal, either to gather it up into a certain precise form, whenever it desires to place its wings under the shelter which nature

mere modifications of the same thing? and as the antennæ of insects are so exceedingly variable in form, may they not be used as organs of touch in some, and of hearing in others?

hath given to them; or to expand again their folds when wanted for action.

In some insects the elytra cover the whole body;[8] in others, half; in others only a small part of it;[9] but in all,[10] they completely hide and cover the true wings. Also,

Many or most of the beetle species lodge in holes in the earth, environed by hard, rough substances, and have frequently to squeeze their way through narrow passages; in which situation, wings so tender, and so large, could scarcely have escaped injury, without both a firm covering to defend them, and the capacity of collecting themselves up under its protection.[11]

[8] From this circumstance beetles (the tribe of insects to which the above description applies) have received the name of *Coleoptera*, from two Greek words signifying *sheath* and *wing*.

[9] A tribe of insects called the *Brachelytra* (or *Staphylinus* of Linnæus) possess wing-cases of this description.

[10] These are exceptions. In the genera *Molorchus*, *Sitaris* (and others might be enumerated among the beetle tribe), the wing-cases are small and narrow, and leave the wings exposed. The species of the genus *Molorchus*, however, do not require such protection for their wings, since they live in flowers. The habits of the *Sitaris* are not so well known; they are said to live in the nests of certain species of bees.

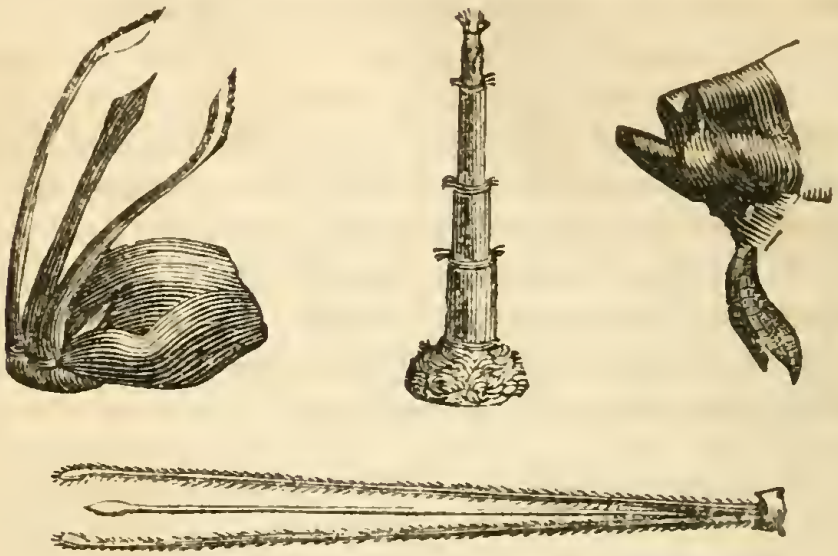
In the earwig the elytra do not entirely cover the wings; but the portion of the wing exposed is of a hornlike substance, like the elytra, whilst the remaining part of the wing is extremely delicate.

[11] A tribe of beetles, coming under the generic name of *Hister*, forms a good illustration of this mode of existence: in these insects the elytra are remarkably hard.

The species of the genus *Hister* possess remarkable analogical resemblances to tortoises, which have somewhat similar habits: like them, they are exceedingly hard, of an oval shape, and have the power of retracting the head beneath a horny covering; they are slothful, and very strong, and burrow in the ground by means of their fore legs.

A great analogical resemblance also exists between an insect called the mole-cricket and the mole, their habits also being similar.

II. Another contrivance, equally mechanical, and equally clear, is the *awl*, or borer, fixed at the tails of



various species of flies; and with which they pierce, in some cases, plants; in others, wood; in others,[12] the skin and flesh of animals; in others, the coat of the chrysalis of insects of a different species from their own;

[12] Almost every caterpillar (perhaps, without exception) has its peculiar parasites among the ichneumonidæ, a different tribe of insects: the same ichneumon almost invariably choosing the same caterpillar to deposit its eggs upon or in; and as the situations in which different caterpillars feed are very various, so is the structure of their parasites. The ichneumons which infest internal feeding caterpillars (*i. e.*, such as feed in the trunk of a tree, or the stem of a plant) are furnished with long ovipositors to enable them to reach the caterpillar through some hole or chink where they themselves cannot get.

Even the ichneumons are not free from parasites. There are instances where four or five different parasitical insects have been found in the same chrysalis (as that of the *Trichiosoma leucorum*, a saw-fly), each one feeding upon the other. Thus several larvæ of an ichneumon may be found feeding upon the inside of a chrysalis; and when these larvæ turn into pupæ or chrysalides, some of the chalcididæ, a different tribe of flies, will feed upon them, and even some of the last may in their turn be eaten up.

and in others, even lime, mortar, and stone.[13] I need not add, that having pierced the substance, they deposit their eggs in the hole. The descriptions which naturalists give of this organ are such as the following :—It is a sharp-pointed instrument, which, in its inactive state, lies concealed in the extremity of the abdomen, and which the animal draws out at pleasure, for the purpose of making a puncture in the leaves, stem, or bark, of the particular plant which is suited to the nourishment of its young. In a sheath, which divides and opens whenever the organ is used, there is inclosed a compact, solid, dentated stem, along which runs a *gutter* or *groove*, by which groove, after the penetration is effected, the egg, assisted in some cases by a peristaltic motion, passes to its destined lodgment. In the œstrum or gad-fly, the wimble[14] *draws out* like the pieces of a spy-glass : the last piece is armed with three hooks, and is able to bore through the hide of an ox. Can any thing more be necessary to display the mechanism, than to relate the fact ?

III. The *stings*[15] of insects, though for a different purpose, are, in their structure, not unlike the piercer. The sharpness to which the point in all of them is wrought ; the temper and firmness of the substance of which it is composed ; the strength of the muscles by which it is darted out, compared with the smallness and weakness of the insect, and with the soft and friable texture of the rest of the body,—are properties of the sting to be noticed, and not a little to be admired. The sting of a *bee* will pierce through a goat-skin glove. It penetrates the human flesh more readily than the finest point of a needle. The *action* of the sting affords an

[13] There is not any accredited instance of any insects perforating so hard a substance as stone, with the 'awl or borer' fixed at the tail. This instrument, technically called ovipositor, is excessively variable in its structure, being scarcely alike in any two species: the description given will answer for that of the saw-fly (*Tenthredo*).

[14] Wimble, or ovipositor.

[15] The stings of insects are also used as ovipositors.

example of the union of chemistry and mechanism, such as, if it be not a proof of contrivance, nothing is. First, as to the chemistry: how highly concentrated must be the *venom*, which, in so small a quantity, can produce such powerful effects! And in the bee we may observe that this venom is made from *honey*, the only food of the insect, but the last material from which I should have expected that an exalted poison could, by any process or digestion whatsoever, have been prepared. In the next place, with respect to the mechanism, the sting is not a simple but a compound instrument. The visible sting, though drawn to a point exquisitely sharp, is in strictness only a sheath, for, near to the extremity, may be perceived by the microscope two minute orifices, from which orifices, in the act of stinging, and, as it should seem, after the point of the main sting has buried itself in the flesh, are launched out two subtile rays, which may be called the true or proper stings, as being those through which the poison is infused into the puncture already made by the exterior sting. I have said that chemistry and mechanism are here *united:* by which observation I meant, that all this machinery would have been useless, *telum imbelle*, if a supply of poison, intense in quality, in proportion to the smallness of the drop, had not been furnished to it by the chemical elaboration which was carried on in the insect's body; and that, on the other hand, the poison, the result of this process, could not have attained its effect, or reached its enemy, if, when it was collected at the extremity of the abdomen, it had not found there a machinery fitted to conduct it to the external situations in which it was to operate, *viz.*, an awl to bore a hole, and a syringe to inject the fluid. Yet these attributes, though combined in their action, are independent in their origin. The venom does not breed the sting; nor does the sting concoct the venom.

IV. The *proboscis*,[16] with which many insects are en-

[16] The part called proboscis in the bee consists of a central stalk, or tongue, *a* (Fig. 1), and four lateral pieces, or jaws, two of which spring from the base, and two have their origin near the middle. The apical half of the stalk is soft and

Fig. 1.

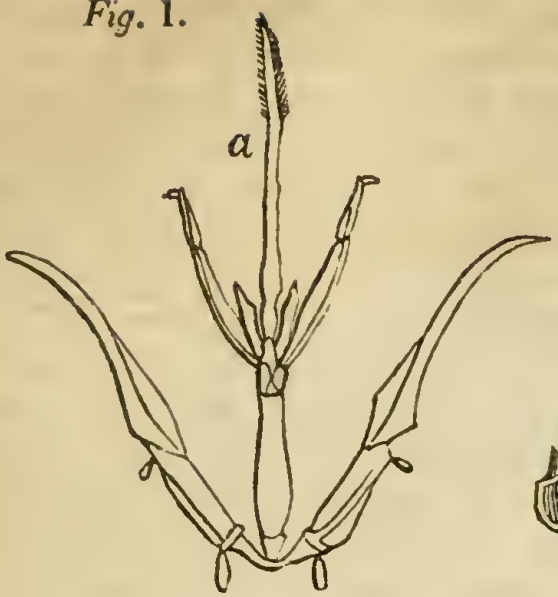
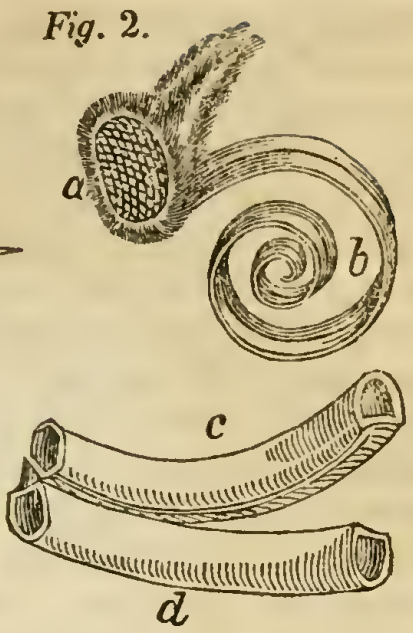


Fig. 2.



dowed, comes next in order to be considered. It is a tube attached to the head of the animal; in the bee, it is composed of two pieces, connected by a joint: for, if it were constantly extended, it would be too much exposed to accidental injuries; therefore, in its indolent state, it is doubled up by means of the joint, and in that position lies secure under a scaly pent-house.[17] In many species of the butterfly, the proboscis, when not in use, is coiled up like a watch-spring. In the same bee, the proboscis serves the office of the mouth, the insect having no other;[18] and how much better adapted it is, than

flexible, rather flat, and covered with minute hairs: it is chiefly this part of the proboscis which is used in collecting honey. Honey is not sucked up as is generally supposed, but licked up, and then conveyed to the œsophagus. The four lateral pieces when closed form a sheath to protect the tongue, and other parts of the central stalk. Fig. 2 represents the profile of a butterfly's head; *a* is the compound eye, and *b* the proboscis partially unfolded; *c* and *d* show portions of the tubes forming the proboscis highly magnified.

[17] There is an indentation in the under side of the head to receive the proboscis when folded up.

[18] A bee has the same number of parts to its mouth as any other insect; the only difference between that of a bee and a beetle is, that some of the parts are more developed in the former: *viz.*, the labium, tongue, and maxillæ.

a mouth would be, for the collecting of the proper nourishment of the animal is sufficiently evident. The food of the bee is the nectar of flowers; a drop of syrup, lodged deep in the bottom of the corollæ, in the recesses of the petals, or down the neck of a monopetalous glove. Into these cells the bee thrusts its long narrow pump, through the cavity of which it sucks[19] up this precious fluid, inaccessible to every other approach. It is observable also, that the plant is not the worse[20] for what the bee does to it. The harmless plunderer rifles the sweets, but leaves the flower uninjured. The ringlets of which the proboscis of the bee is composed, the muscles by which it is extended and contracted, form so many microscopical wonders. The agility also with which it is moved can hardly fail to excite admiration. But it is

[19] See Note 18. It might be more correct to say *licks up*, for there is no tube.

[20] Bees are essential to the fructification of many sorts of plants, for it is by them that the farina is carried from the male to the female flowers; and as some flowers yield a much greater quantity of honey than others, it might perhaps be imagined that those yielding little, and yet depending upon the bees for their fructification, might often be barren. No such defects, however, are to be found: the structure of the proboscis varies considerably in different species of bees, so that all bees cannot collect indiscriminately from any honey-yielding plant. One great tribe of bees (the *apidæ*) collect their honey for the most part from bell-shaped flowers, such as the blind nettle, &c.; their long proboscis enabling them to reach the bottom of the bells. Another tribe, having the proboscis short, are obliged to collect from flowers of a different shape. There is yet another circumstance which leads the different sorts of bees to visit a variety of flowers: *viz.*, that they do not feed their larvæ on the same substance. If we examine the cells of some (the *andrænidæ*), we find that the food stored up for the young consists of a ball of farina, which has scarcely any admixture of honey: these bees would naturally seek those flowers which yield the most farina; whereas in others (the *apidæ*) honey with very little farina is stored up for the young.

enough for our purpose to observe, in general, the suitableness of the structure to the use of the means to the end, and especially the wisdom by which nature has departed from its most general analogy (for animals being furnished with mouths are such), when the purpose could be better answered by the deviation.

In some insects the proboscis, or tongue, or trunk, is shut up in a sharp-pointed sheath, which sheath,[21] being of a much firmer texture than the proboscis itself, as well as sharpened at the point, pierces the substance which contains the food, and then *opens within the wound*, to allow the enclosed tube, through which the juice is extracted, to perform its office. Can any mechanism be plainer than this is, or surpass this?

V. The *metamorphosis* of insects from grubs into moths and flies is an astonishing process. A hairy caterpillar is transformed into a butterfly. Observe the change. We have four beautiful wings where there were none before—a tubular proboscis in the place of a mouth with jaws and teeth,[22] six long legs instead of

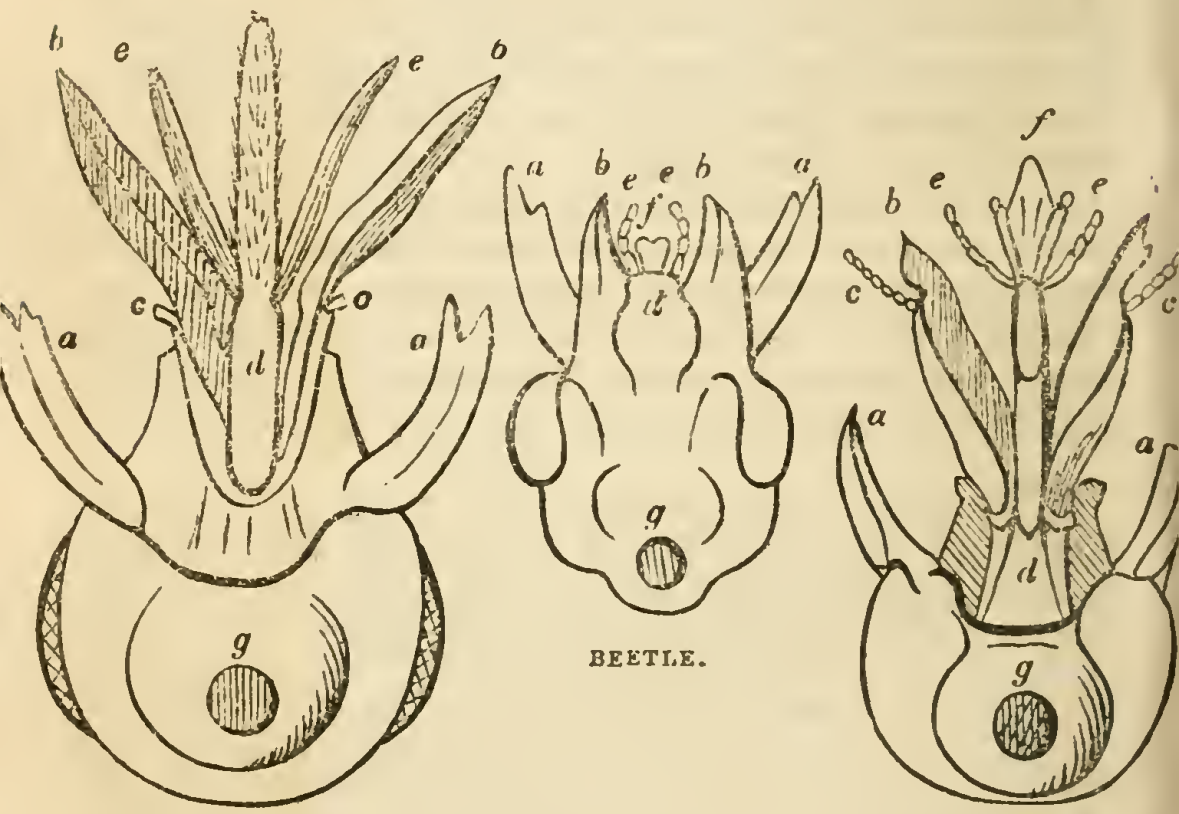
[21] The mouth of the common flea (*Pulex irritans*) is of this nature; it is composed of seven pieces, a pair of *mandibles*, a pair of *maxillæ*, two *palpi* or feelers, and a *tongue*. The uses of these pieces appear to be as follows:—the *mandibles*, which are short, strong, and sharp, are to cut through the outer skin; the *maxillæ*, which are long and shaped like lancets, are to pierce still deeper so as to cause bleeding: the *tongue* is then used to lick and convey the blood to the œsophagus; and the *palpi* are to direct these operations, conveying information to the animal by feeling or touch. These same seven parts (forming the mouth, and technically called *trophi*) are to be found in almost all insects, but constructed in different ways to suit the various habits of the species.

[22] The mouth of the caterpillar, or larva state of insects, has, in the greater portion of the species, the same number of parts as that of the perfect insect. In the pupa state some of these parts become nearly or quite obliterated, whilst others are much more developed to suit the habits of the animal in its next or perfect state of existence; and thus, of course, in some instances, where there is but little difference between the habits of the larva and those of the perfect insect, there is

fourteen feet. In another case we see a white, smooth, soft worm turned into a black, hard, crustaceous beetle

likewise but little difference in the structure of the mouth, as, for instance, in locusts, grasshoppers, and cockroaches.

In the butterfly tribe the maxillæ or under jaws of the caterpillar become in the perfect insect elongated into two tubes (see Cut), which may be joined together at the pleasure of the animal, by means of projecting ridges (furnished with a sort of hook somewhat like the laminæ of feathers),



HUMBLE BEE. BEETLE. BEE.

a, *a*, mandibles; *c*, *c*, maxillary palpi; *e*, *e*, labial palpi;
b, *b*, maxillæ; *d*, *d*, labium; *f*, tongue; *g*, neck.

in such a way as to leave a third tube between the two. It is through the central tube that the nectar is pumped or sucked up; the two outer tubes Réaumur imagines are for the reception of air: if this be the case, it may possibly be that air which is discharged from the central tube to create the necessary vacuum. The mandibles, or upper jaws, and other parts conspicuous in the caterpillar, are to be found only in a rudimentary state in the butterfly,—yet they do exist.

with gauze wings. These, as I said, are astonishing processes, and must require, as it should seem, a proportionably artificial apparatus. The hypothesis which appears to me most probable is, that, in the grub, there exist at the same time three animals, one within another, all nourished by the same digestion, and by a communicating circulation, but in different stages of maturity.[23] The latest discoveries made by naturalists seem to favour this supposition. The insect already equipped with wings, is described under the membranes both of the worm and nymph. In some species the proboscis, the

[23] The following observations do not exactly support the opinion of Dr. Paley. It is more probable that the parts which are to appear in the perfect insect do *not* exist in the larvæ, where there is not much difference between the larva and pupa excepting at the time just previous to its becoming a pupa, at which time the larva is motionless and torpid. The caterpillar of a moth, when about to turn into a pupa, provides for the protection of the latter state, either by surrounding itself with a web, or by some other means. Soon after this is accomplished the caterpillar becomes motionless, or nearly so; it can neither eat nor crawl. At this time, and *not before*, the parts of the pupa are forming within the skin of the caterpillar, which may be easily seen by dissection. When the difference between the larva and the perfect insect is great, this is always the case, and the pupa is passive; but when the difference is not so considerable, the case is different. The larva of a grasshopper scarcely differs from the perfect insect it is to become, except in wanting wings; the pupa differs only in having rudimentary instead of perfect wings; it casts its skin; it is then the perfect insect, excepting that the wings are crippled, and these very rapidly expand. In this latter case it is seen that there is but little difference between the three stages, and the change from the caterpillar to the moth is very great, and takes place only during the torpid state of the former, which state is to allow of its taking place. In the case of the grasshopper, where the changes are but slight, we should imagine but little of this torpidity would be required: and such appears to be the case, for the pupæ of grasshoppers, and allied insects, are always as active as either the larva or perfect insect.

antennæ, the limbs, and wings of the fly have been observed to be folded up within the body of the caterpillar, and with such nicety as to occupy a small space only under the two first wings. This being so, the outermost animal which, besides its own proper character, serves as an integument to the other two, being the farthest advanced, dies, as we suppose, and drops off first. The second, the pupa or chrysalis, then offers itself to observation. This also, in its turn, dies; its dead and brittle husk falls to pieces, and makes way for the appearance of the fly or moth. Now if this be the case, or indeed whatever explication be adopted, we have a prospective contrivance of the most curious kind; we have organizations *three deep*, yet a vascular system which supplies nutrition, growth, and life to all of them together.

VI. Almost all insects are oviparous. Nature keeps her butterflies, moths, and caterpillars locked up during the winter in their egg-state; and we have to admire the various devices to which, if we may so speak, the same nature hath resorted for the *security* of the egg. Many insects enclose their eggs in a silken web; others cover them with a coat of hair torn from their own bodies; some glue them together; and others, like the moth of the silk-worm, glue them to the leaves upon which they are deposited, that they may not be shaken off by the wind, or washed away by rain. Some, again, make incisions into leaves, and hide an egg in each incision; whilst some envelope their eggs with a soft substance which forms the first aliment of the young animal; and some again make a hole in the earth, and, having stored it with a quantity of proper food, deposit their eggs in it. In all which we are to observe, that the expedient depends not so much upon the address of the animal, as upon the physical resources of his constitution.

The art also with which the young insect is *coiled up* in the egg presents, where it can be examined, a subject of great curiosity. The insect, furnished with all the members which it ought to have, is rolled up into a form

which seems to contract it into the least possible space; by which contraction, notwithstanding the smallness of the egg, it has room enough in its apartment, and to spare. This folding of the limbs appears to me to indicate a special direction; for if it were merely the effect of compression, the collocation of the parts would be more various than it is. In the same species, I believe, it is always the same.

These observations belong to the whole insect tribe, or to a great part of them. Other observations are limited to fewer species, but not, perhaps, less important or satisfactory.

I. The organization in the abdomen of the *silkworm* or *spider*, whereby these insects form their *thread*, is as incontestably mechanical as a wire-drawer's mill. In the body of the silkworm are two bags, remarkable for their

form, position, and use. They wind round the intestine; when drawn out they are ten inches in length, though the animal itself be only two. Within these bags is collected a glue; and, communicating with the bags, are two paps or outlets, perforated like a grater by a number of small holes. The glue or gum, being passed through these minute apertures, forms hairs of almost imperceptible fineness; and these hairs, when joined, compose the silk which we wind off from the cone in which the silkworm has wrapped itself up: in the spider, the web is formed from this thread. In both cases, the extremity of the thread, by means of its adhesive quality, is first attached by the animal to some external hold; and the end being now fastened to a point, the insect, by turning round its body, or by receding from that point, draws out the thread through the holes above described, by an operation, as hath been observed, exactly similar to the drawing of wire. The

thread, like the wire, is formed by the hole through which it passes. In one respect there is a difference. The wire is the metal unaltered, except in figure. In the animal process the nature of the substance is somewhat changed as well as the form; for, as it exists within the insect, it is a soft, clammy gum or glue. The thread acquires, it is probable, its firmness and tenacity from the action of the air upon its surface in the moment of exposure; and a thread so fine is almost all surface. This property, however, of the paste is part of the contrivance.

The mechanism itself consists of the bags or reservoirs into which the glue is collected, and of the external holes communicating with these bags; and the action of the machine is seen in the forming of a thread, as wire is formed, by forcing the material already prepared through holes of proper dimensions. The secretion is an act too subtile for our discernment, except as we perceive it by the produce. But one thing answers to another; the secretory glands to the quality and consistence required in the secreted substance; the bag to its reception. The outlets and orifices are constructed not merely for relieving the reservoirs of their burden, but for manufacturing the contents into a form and texture of great external use, or rather, indeed, of future necessity, to the life and functions of the insect.

II. Bees, under one character or other, have furnished every naturalist with a set of observations. I shall, in this place, confine myself to one; and that is the *relation* which obtains between the wax and the honey. No person who has inspected a bee-hive can forbear remarking how commodiously the honey is bestowed in the comb, and, amongst other advantages, how effectually the fermentation of the honey is prevented by distributing it into small cells. The fact is, that when the honey is separated from the comb, and put into jars, it runs into fermentation with a much less degree of heat than what takes place in a hive. This may be reckoned a nicety; but, independently of any nicety in the matter, I would ask, what could the bee

do with the honey if it had not the wax? how, at least, could it store it up for winter? The wax, therefore, answers a purpose with respect to the honey; and the honey constitutes that purpose with respect to the wax. This is the relation between them. But the two substances, though together of the greatest use, and without each other of little, come from a different origin. The bee finds the honey, but makes the wax. The honey is lodged in the nectaria of flowers, and probably undergoes little alteration—is merely collected; whereas the wax is a ductile tenacious paste, made out of a dry powder,[24] not simply by kneading it with a liquid, but by a digestive process in the body of the bee. What account can be rendered of facts so circumstanced, but that the animal, being intended to feed upon honey, was, by a peculiar external configuration, enabled to procure it? That, moreover, wanting the honey when it could not be procured at all, it was further endued with the no less necessary faculty of constructing repositories for its preservation? Which faculty, it is evident, must depend primarily upon the capacity of providing suitable materials. Two distinct functions go to make up the ability. First, the power in the bee, with respect to wax, of loading the farina of flowers upon its thighs. Microscopic observers speak of the spoon-shaped appendages with which the thighs of bees are beset for this very purpose; but, inasmuch as the art and will of the bee may be supposed to be concerned in this operation, there is, secondly, that which doth not rest in art or will—a digestive faculty, which converts the loose powder into a stiff substance. This is a just account of the honey and the honey-comb; and this account, through every part, carries a creative intelligence along with it.[25]

[24] The opinion of Huber, Hunter, and others, is, that wax is not made out of pollen, but from honey. Huber kept some bees confined, and fed them with honey only, and wax was secreted as usual. It is most likely that bees never eat farina, and that it is collected for the larvæ only. See article Bee, 'Penny Cyclopædia.'

[25] It has often been remarked, that Dr. Paley does not,

The *sting* also of the bee has this relation to the honey, that it is necessary for the protection of a treasure which invites so many robbers.

III. Our business is with mechanism. In the *panorpa* tribe of insects, there is a forceps in the tail of the male insect with which he catches and holds the female. Are a pair of pincers more mechanical than this provision in its structure? or is any structure more clear and certain in its design ?[26]

IV. St. Pierre tells us,* that in a fly with six feet (I do not remember that he describes the species), the pair next the head and the pair next the tail have brushes at their extremities, with which the fly dresses, as there may be occasion, the anterior or the posterior part of its body; but that the middle pair have no such brushes, the situation of these legs not admitting of the brushes, if they were there, being converted to the same use. This is a very exact mechanical distinction.[27]

either in this chapter, or in that on instinct, state the most remarkable of all instincts, and of all the labours of insects, the formation of the cells by the bee according to the strictest geometrical rules. The history of this discovery made (through Réaumur's suggestion) by Kœnig's application of the fluxional calculus, and by its result being found to tally with Maraldi's measurement, will be given in the Appendix. Maclaurin solved the same problem afterwards by the help of plane geometry, with a truly felicitous skill. The angles actually made differ by about two minutes from those given by the calculus; but no one can doubt that subsequent discovery will explain this.

[26] In the genus *Trichius* (a tribe of beetles closely allied to the rose beetle) the males have the tibiæ of the middle pair of legs curved for the same purpose.

[27] The stag-beetle (*Lucanus cervus*) cleans its antennæ "by drawing them between the thigh of the foreleg and the underside of the thorax, in both of which parts a velvet-like patch of hair is to be observed, which is well adapted for such purpose." See this, and other peculiarities in the same insect, in the first Part of the Entomological Society's Transactions, in 'The Journal of Proceedings,' page 6.

* Vol. i. p. 342.

V. If the reader, looking to our distributions of science, wish to contemplate the chemistry as well as the mechanism of nature, the insect creation will afford him an example. I refer to the light in the tail of a *glow-worm*. Two points seem to be agreed upon by naturalists concerning it: first, that it is phosphoric; secondly, that its use is to attract the male insect. The only thing to be inquired after is the singularity, if any such there be, in the natural history of this animal, which should render a provision of this kind more necessary for it than for other insects. That singularity seems to be the difference which subsists between the male and the female, which difference is greater than what we find in any other species of animal whatever. The glow-worm is a female *caterpillar*, the male of which is a *fly*, lively, comparatively small, dissimilar to the female in appearance, probably also as distinguished from her in habits, pursuits, and manners, as he is unlike in form and external constitution. Here then is the adversity of the case. The caterpillar cannot meet her companion in the air. The winged rover disdains the ground. They might never therefore be brought together did not this radiant torch direct the volatile mate to his sedentary female.[28]

In this example we also see the resources of art anticipated. One grand operation of chemistry is the making of phosphorus; and it was thought an ingenious device to make phosphoric matches supply the place of lighted tapers. Now this very thing is done in the body of the glow-worm. The phosphorus is not only made,

[28] The female glow-worm undergoes the same transformations as all other insects, and its perfect state differs considerably from its larva or caterpillar state, though in both stages it emits the phosphoric light. Besides the ordinary sexual distinctions, the female glow-worm differs from the male only in being apterous; but apterous female insects are not unfrequent; thus many species of moths have no wings. The two circumstances of the sedentary habits of the female, and the males flying by night only, seem to show the use of the light. See the next note.

but kindled, and caused to emit a steady and genial beam, for the purpose which is here stated, and which I believe to be the true one.[29]

VI. Nor is the last the only instance that entomology affords, in which our discoveries, or rather our projects, turn out to be imitations of nature. Some years ago, a plan was suggested of producing propulsion by re-action in this way: by the force of a steam-engine, a stream of water was to be shot out of the stern of a boat, the impulse of which stream upon the water in the river was to push the boat itself forward; it is in truth the principle by which sky-rockets ascend in the air. Of the use or practicability of the plan I am not speaking; nor is it my concern to praise its ingenuity; but it is certainly a contrivance. Now, if naturalists are to be believed, it is exactly the device which nature has made use of for the motion of some species of aquatic insects. The larva of the *dragon-fly*, according to Adams, swims by ejecting water from its tail—is driven forward by the re-action of water in the pool upon the current issuing in a direction backward from its body.

VII. Again: Europe has lately been surprised by the elevation of bodies in the air by means of a balloon. The discovery consisted in finding out a manageable substance, which was, bulk for bulk, lighter than air; and the application of the discovery was to make a body composed of this substance bear up, along with its own weight, some heavier body which was attached to it. This expedient, so new to us, proves to be no other than what the Author of nature has employed in the *gossamer*

[29] There exists some controversy among naturalists as to the use of the glow-worm's light. The doubt has been chiefly raised by the observation that the insect is luminous, though in an imperfect degree, when in the state in which it cannot propagate, as mentioned in the last note; and that other insects are attracted by light as well as the male glow-worm. The preponderance of the argument is decidedly in favour of the supposition adopted by our author, and which is also the commonly received opinion. The particulars of the discussion will be given in the Appendix.

spider. We frequently see this spider's thread floating in the air, and extended from hedge to hedge across a road or brook of four or five yards' width. The animal which forms the thread has no wings wherewith to fly from one extremity to the other of this line, nor muscles to enable it to spring or dart to so great a distance: yet its Creator hath laid for it a path in the atmosphere; and after this manner. Though the animal itself be heavier than air, the thread which it spins from its bowels is specifically lighter. This is its *balloon*. The spider, left to itself, would drop to the ground; but being tied to its thread, both are supported. We have here a very peculiar provision; and to a contemplative eye it is a gratifying spectacle to see this insect wafted on her thread, sustained by a levity not her own, and traversing regions which, if we examined only the body of the animal, might seem to have been forbidden to its nature.[30]

I must now crave the reader's permission to introduce into this place, for want of a better, an observation or two upon the tribe of animals, whether belonging to land or water, which are covered by *shells*.

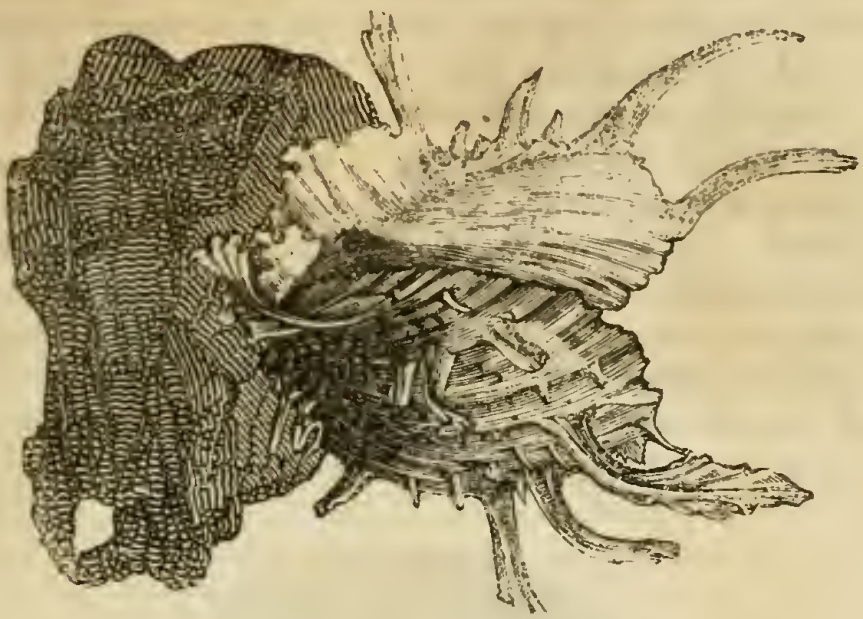
I. The *shells* of *snails* are a wonderful, a mechanical, and, if one might so speak concerning the works of nature, an original contrivance. Other animals have their proper retreats, their hybernacula also, or winter-quarters, but the snail carries these about with him. He travels with his tent; and this tent, though, as was necessary, both light and thin, is completely impervious either to moisture or air. The young snail comes out of its egg with the shell upon its back; and the gradual enlargement which the shell receives is derived from the

[30] It was at one time supposed that the spider could project its thread through the air at will in any direction, and thus attaching it to different bodies, move from one to the other. The observations more accurately made of late years, show that this power is not possessed by the animal, but that it requires the aid of a current of air to direct the thread. This correction, however, of the former opinion, in no way weakens the force of the argument in the text.

Helix aspersa of Müller,—common garden snail; but the cut represents what is called a left-handed shell, and a rarity.

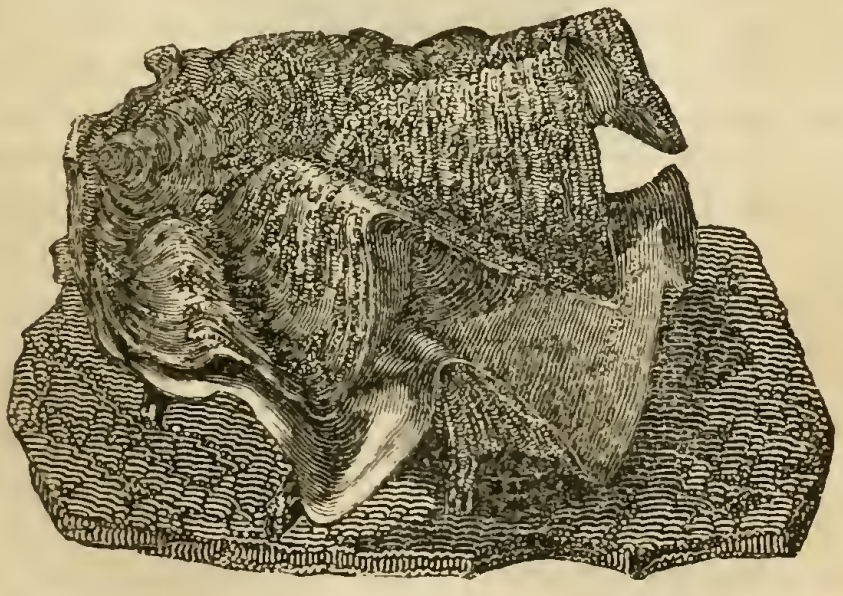
slime excreted by the animal's skin. Now the aptness of this excretion to the purpose, its property of hardening into a shell, and the action, whatever it be, of the animal, whereby it avails itself of its gift, and of the constitution of its glands (to say nothing of the work being commenced before the animal is born), are things which can, with no probability, be referred to any other cause than to express design; and that not on the part of the animal alone, in which design, though it might build the house, it could not have supplied the material. The will of the animal could not determine the quality of the excretion. Add to which, that the shell of the snail, with its pillar and convolution, is a very artificial fabric; whilst a snail, as it should seem, is the most numb and unprovided of all artificers. In the midst of variety there is likewise a regularity which could hardly be expected. In the same species of snail the number of turns is usually, if not always, the same. The scaling

up of the mouth of the shell by the snail is also well calculated for its warmth and security; but the cerate is not of the same substance with the shell.



Spondylus—prickly oyster.

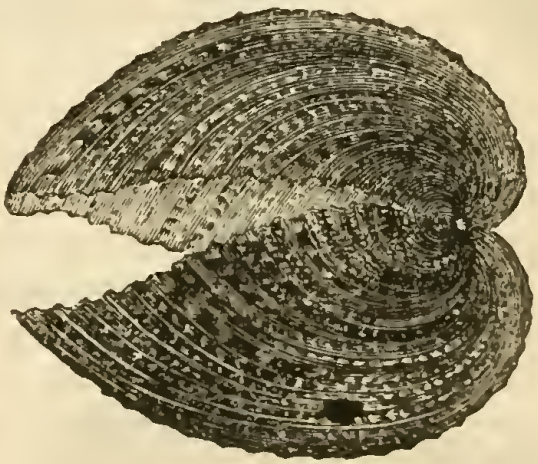
II. Much of what has been observed of snails belongs to *shell-fish* and their *shells*, particularly to those of the univalve kind; with the addition of two remarks – one of which is upon the great strength and hardness of most



Ostrea crista galli of Lamarck, *Mytilus crista galli* of Linnæus—the cock's-comb oyster.

of these shells. I do not know whether, the weight being given, art can produce so strong a case as are some of these shells; which defensive strength suits well with the life of an animal that has often to sustain the dangers of a stormy element and a rocky bottom, as well as the attacks of voracious fish. The other remark is upon the property, in the animal exeretion, not only of congealing, but of congealing or, as a builder would call it, *setting*, in water, and into a cretaceous substance, firm and hard. This property is much more extraordinary, and, chemically speaking, more specific, than that of hardening in the air, which may be reckoned a kind of exsiccation, like the drying of clay into bricks.

III. In the *bivalve* order of shell-fish, cockles, mussels, oysters, &c., what contrivance can be so simple or



Cardium cardissa—Venus' heart cockle.

so clear as the insertion, at the back, of a tough tendinous substance that becomes at once the ligament which binds the two shells together, and the *hinge* upon which they open and shut?

IV. The shell of a lobster's tail, in its articulations and overlappings, represents the jointed part of a coat of mail; or rather, which I believe to be the truth, a coat of mail is an imitation of a lobster's shell. The same end is to be answered by both; the same properties, therefore, are required in both, namely, hardness and flexibility—a covering which may guard the part without

obstructing its motion. For this double purpose the art of man, expressly exercised upon the subject, has not been able to devise anything better than what nature presents to his observation. Is not this therefore mechanism, which the mechanic, having a similar purpose in view, adopts? Is the structure of a coat of mail to be referred to art? Is the same structure of the lobster, conducing to the same use, to be referred to anything less than art?

Some who may acknowledge the imitation, and assent to the inference which we draw from it in the instance before us, may be disposed, possibly, to ask, why such imitations are not more frequent than they are, if it be true, as we allege, that the same principle of intelligence, design, and mechanical contrivance was exerted in the formation of natural bodies as we employ in the making of the various instruments by which our purposes are served? The answers to this question are, first, that it seldom happens that precisely the same purpose, and no other, is pursued in any work which we compare of nature and of art; secondly, that it still more seldom happens that we *can* imitate nature if we would. Our materials and our workmanship are equally deficient. Springs and wires, and cork and leather, produce a poor substitute for an arm or a hand. In the example which we have selected, I mean a lobster's shell compared with a coat of mail, these difficulties stand less in the way than in almost any other that can be assigned; and the consequence is, as we have seen, that art gladly borrows from nature her contrivance, and imitates it closely.

But to return to insects. I think it is in this class of animals above all others, especially when we take in the multitude of species which the microscope discovers, that we are struck with what Cicero has called "the *insatiable* variety of nature." There are said to be six thousand species of flies; seven hundred and sixty butterflies; each different from all the rest (St. Pierre).[31] The

[31] There are collections of insects in this country which,

same writer tells us, from his own observation, that thirty-seven species of winged insects, with distinctions well expressed, visited a single strawberry-plant in the course of three weeks.* Ray observed, within the compass of a mile or two of his own house, two hundred kinds of butterflies,[32] nocturnal and diurnal. He likewise asserts, but, I think, without any grounds of exact computation, that the number of species of insects, reckoning all sorts of them, may not be short of ten thousand.† And in this vast variety of animal forms (for the observation is not confined to insects, though more applicable perhaps to them than to any other class), we are sometimes led to take notice of the different methods, or rather of the studiously diversified methods, by which one and the same purpose is attained. In the article of breathing, for example, which was to be provided for in some way or other, besides the ordinary varieties of lungs, gills, and breathing-holes (for insects in general respire, not by the mouth, but through holes in the sides), the nymphæ of gnats have an apparatus to raise their *backs* to the top of the water, and so take breath. The hydrocanthari do the like by thrusting their *tails* out of the water.‡ The maggot of the eruca labra has a long tail, one part sheathed within another (but which it can draw out at pleasure), with a starry tuft at the end, by which *tuft*, when expanded upon the surface, the insect both supports itself in the water, and

in all probability, contain forty thousand species. The number of species in existence may fairly be reckoned at sixty or eighty thousand. Mr. Stephens, in his catalogue of British insects, enumerates ten thousand, since the publication of which many new species have been discovered. We are now speaking of true insects,—animals having six legs, &c.,—and not including crabs, spiders, scorpions, and others, which *have been* classed with insects.

[32] Ray must mean butterflies and *moths*,—we have not one hundred species of butterflies in this country; and besides, no butterflies are "nocturnal."

* Vol. i. p. 3. † Wisd. of God, p. 23.

‡ Derham, p. 7.

draws in the air which is necessary. In the article of natural clothing, we have the skins of animals invested with scales, hair, feathers, mucus, froth, or itself turned into a shell or crust. In the no less necessary article of offence and defence, we have teeth, talons, beaks, horns, stings, prickles, with (the most singular expedient for the same purpose) the power of giving the electric shock, and, as is credibly related of some animals, of driving away their pursuers by an intolerable fœtor, or of blackening the water through which they are pursued. The consideration of these appearances might induce us to believe that *variety* itself, distinct from every other reason, was a motive in the mind of the Creator, or with the agents of his will.

To this great variety in organised life the Deity has given, or perhaps there arises out of it, a corresponding variety of animal *appetites*. For the final cause of this we have not far to seek. Did all animals covet the same element, retreat, or food, it is evident how much fewer could be supplied and accommodated than what at present live conveniently together, and find a plentiful subsistence. What one nature rejects another delights in. Food which is nauseous to one tribe of animals becomes, by that very property which makes it nauseous, an alluring dainty to another tribe. Carrion is a treat to dogs, ravens, vultures, fish.[33] The exhalations of corrupted substances attract flies by crowds. Maggots revel in putrefaction.[34]

[33] Very many insects subsist entirely upon carrion, both in the larva and imago state, and in hot weather must be highly serviceable in removing such noxious substances. In this point of view the maggots of flies are exceedingly useful; a carcase becoming speedily threaded in every direction by them, is soon either devoured or wasted.

[34] The most remarkable circumstance relative to instinct, as well as to the habits of insects, the architecture of the bee, has been observed upon in a former note. The manufacture of the wasp perhaps comes next, and is to the chemistry what the former is to the mathematics of instinct. It furnishes, too, one of the most striking instances of the discoveries of

man having been anticipated by the lower animals; and is another remarkable proof how many more might have been made by closely attending to their habits,—perhaps a more remarkable proof than those referred to in the text of this chapter, and hinted at in chapter viii., where the author is treating of the vertebræ and ribs. It is certain that some of the most material improvements in paper-making recently introduced, as the use of other substances besides rags, and the obtaining toughness by means of long fibres, had been known to the wasp from its first creation. Its whole process in making what is called *wasp-paper* is precisely that of the best paper-makers. This will be illustrated in the Appendix. It is only mentioned here as another among the striking instances of the Divine agency through the operations of unreasoning animals—instances which fill the contemplative mind with the most profound and pleasing admiration, and dispose it to the enjoyment and the duty of heartfelt devotion.

The migration of birds is another subject full of instruction regarding the great questions connected with instinct, and is reserved for the Appendix. Observation seems at variance with the notion of the older birds teaching the yearlings; indeed, the two classes have been found not to travel together. But the agitation universally observed in birds of passage kept in cages, at the season of migration, proves clearly that no experience nor instruction will account for the change of place. See Mr. W. Herbert's excellent remarks on this instinct, and on the similar instincts respecting choice of food, which makes birds bred in a cage at once select their appointed food when shown them for the first time (White's Selborne, edit. 1833, p. 41 *et seq.*) The facts respecting carrier-pigeons and other animals finding their way through countries in the knowledge of which they never could have been trained, belong to the same class, and will be particularly discussed in the Appendix—Dissertation upon Instinct. The doctrine of conflicting instincts will be considered under the head of conflicting contrivances in the Dissertations upon Evil, and adverted to in the Notes on the last chapter. Such apparent conflicts afford no ground whatever for the sceptical argument as to design; and they in no way strengthen the sceptical argument drawn, and inaccurately drawn, from other sources, respecting benevolence.

CHAPTER XX.

OF PLANTS.

I THINK a designed and studied mechanism to be in general more evident in animals than in *plants:* and it is unnecessary to dwell upon a weaker argument where a stronger is at hand. There are, however, a few observations upon the vegetable kingdom which lie so directly in our way, that it would be improper to pass by them without notice.

The one great intention of nature in the structure of plants seems to be the perfecting of the *seed*, and, what is part of the same intention, the preserving of it until it be *perfected*. This intention shows itself, in the first place, by the care which appears to be taken to protect and ripen, by every advantage which can be given to them of situation in the plant, those parts which most immediately contribute to fructification, viz. the antheræ, the stamina, and the stigmata. These parts are usually lodged in the centre, the recesses, or the labyrinths of the flower—during their tender and immature state are shut up in the stalk, or sheltered in the bud—as soon as they have acquired firmness of texture sufficient to bear exposure, and are ready to perform the important office which is assigned to them, they are disclosed to the light and air by the bursting of the stem or the expansion of the petals; after which they have, in many cases, by the very form of the flower during its blow, the light and warmth reflected upon them from the concave side of the cup. What is called also the *sleep* of plants is the leaves or petals disposing themselves in such a manner as to shelter the young stems, buds, or fruit. They turn up, or they fall down, according as this purpose renders either change of position requisite. In the

growth of corn, whenever the plant begins to shoot, the two upper leaves of the stalk join together, embrace the ear, and protect it till the pulp has acquired a certain degree of consistency. In some water-plants the flowering and fecundation are carried on *within* the stem, which afterwards opens to let loose the impregnated seed.* The *pea*, or papilionaceous, tribe enclose the parts of fructification within a beautiful folding of the internal blossom, sometimes called, from its shape, the boat or keel—itself also protected under a penthouse formed by the external petals. This structure is very artificial; and what adds to the value of it, though it may diminish the curiosity, very general. It has also this further advantage (and it is an advantage strictly mechanical), that all the blossoms turn their *backs* to the wind whenever the gale blows strong

Papaver rhœas—Poppy.

enough to endanger the delicate parts upon which the seed depends. I have observed this a hundred times in a field of peas in blossom. It is an aptitude which results from the figure of the flower, and, as we have said,

* Philos. Transact., part ii. 1796, p. 502.

is strictly mechanical, as much so as the turning of a weather-board or tin cap upon the top of a chimney. Of the *poppy*, and of many similar species of flowers, the head while it is growing hangs down, a rigid curvature in the upper part of the stem giving to it that position; and in that position it is impenetrable by rain or moisture. When the head has acquired its size and is ready to open, the stalk *erects* itself for the purpose, as it should seem, of presenting the flower, and with the flower the instruments of fructification, to the genial influence of the sun's rays. This always struck me as a curious property, and specifically as well as originally provided for in the constitution of the plant; for if the stem be only bent by the weight of the head, how comes it to straighten itself when the head is the heaviest? These instances show the attention of nature to this principal object, the safety and maturation of the parts upon which the seed depends.

In *trees*, especially in those which are natives of colder climates, this point is taken up earlier. Many of these trees (observe in particular the *ash* and the *horse-chestnut*) produce the embryos of the leaves and flowers in one year, and bring them to perfection the following. There is a winter therefore to be gotten over. Now what we are to remark is, how nature has prepared for the trials and severities of that season. These tender embryos are, in the first place, wrapped up with a compactness which no art can imitate; in which state they compose what we call the bud. This is not all. The bud itself is enclosed in scales; which scales are formed from the remains of past leaves, and the rudiments of future ones.[35]

[35] This is not exactly true. Buds are not enclosed in scales formed from the remains of past leaves, except in a few rare instances, to which it cannot be supposed that the author refers; neither are they protected by what can correctly be called the rudiments of future leaves, or are only protected in part. The extensive scales of a bud, those in which the office of protection more especially resides, are rudimentary leaves, which are formed at the end of the season, when the force of development in the vegetable sys-

Neither is this the whole. In the coldest climates a third preservative is added, by the bud having a *coat* of gum or resin, which, being congealed, resists the strongest frosts. On the approach of warm weather this gum is softened, and ceases to be a hindrance to the expansion of the leaves and flowers. All this care is part of that system of provisions which has for its object and consummation the production and perfecting of the seeds.

The SEEDS themselves are packed up in a *capsule*, a vessel composed of coats, which, compared with the rest of the flower, are strong and tough. From this vessel projects a tube, through which tube the farina, or some subtile fecundating effluvium that issues from it, is admitted to the seed. And here also occurs a mechanical variety, accommodated to the different circumstances under which the same purpose is to be accomplished. In flowers which are erect, the pistil is shorter than the stamina; and the pollen, shed from the antheræ into the cup of the flower, is caught in its descent by the head of the pistil, called the stigma. But how is this managed when the flowers hang down (as does the crown-imperial for instance), and in which position, the farina, in its fall, would be carried from the stigma, and not towards it? The relative length of the parts is now inverted. The pistil in these flowers is usually longer, instead of shorter, than the stamina, that its protruding summit may receive the pollen as it drops to the ground. In some cases (as in the *nigella*), where the shafts of the pistils or stiles are disproportionably long, they bend down their extremities upon the antheræ, that the necessary approximation may be effected.

But (to pursue this great work in its progress), the impregnation, to which all this machinery relates, being completed, the other parts of the flower fade and drop off, whilst the *gravid seed-vessel*, on the contrary, proceeds to increase its bulk, always to a great, and, in

tem is weak and imperfect; they do not become leaves another season, but are simply thrown off by the expansion of the leaves which unfold from within them.

some species (in the gourd, for example, and melon), to a surprising comparative size; assuming in different plants an incalculable variety of forms, but all evidently conducing to the security of the seed. By virtue of this process, so necessary, but so diversified, we have the seed at length, in stone-fruits and nuts, incased in a strong shell, the shell itself enclosed in a pulp or husk, by which the seed within is, or hath been, fed; or, more generally (as in grapes, oranges, and the numerous kinds of berries), plunged overhead in a glutinous syrup, contained within a skin or bladder: at other times (as in apples and pears) embedded in the heart of a firm fleshy substance; or (as in strawberries) pricked into the surface of a soft pulp.

These and many more varieties exist in what we call *fruits.** In pulse, and grain, and grasses; in trees, and

* From the conformation of fruits alone, one might be led, even without experience, to suppose that part of this provision was destined for the utilities of animals. As limited to the plant, the provision itself seems to go beyond its object. The flesh of an apple, the pulp of an orange, the meat of a plum, the fatness of the olive, appear to be *more* than sufficient for the nourishing of the seed or kernel. The event shows that this redundancy, if it be one, ministers to the support and gratification of animal natures; and when we observe a provision to be more than sufficient for one purpose, yet wanted for another purpose, it is not unfair to conclude that both purposes were contemplated together. It favours this view of the subject to remark, that fruits are not (which they might have been) ready altogether, but that they ripen in succession throughout a great part of the year; some in summer; some in autumn; that some require the slow maturation of the winter, and supply the spring; also that the coldest fruits grow in the hottest places. Cucumbers, pine-apples, melons, are the natural produce of warm climates, and contribute greatly, by their coolness, to the refreshment of the inhabitants of those countries.

I will add to this note the following observation communicated to me by Mr. Brinkley.

"The eatable part of the cherry or peach first serves the purposes of perfecting the seed or kernel, by means of vessels passing through the stone, and which are very visible in a

shrubs, and flowers; the variety of the seed-vessels is incomputable. We have the seeds (as in the pea tribe) regularly disposed in parchment pods, which, though soft and membranous, completely exclude the wet even in the heaviest rains; the pod also, not seldom (as in the bean), lined with a fine down; at other times (as in the senna) distended like a blown bladder: or we have the seed enveloped in wool (as in the cotton plant), lodged (as in pines) between the hard and compact scales of a cone, or barricadoed (as in the artichoke and thistle) with spikes and prickles; in mushrooms, placed under a pent-house; in ferns, within slits in the back part of the leaf: or (which is the most general organization of all) we find them covered by strong, close tunicles, and attached to the stem according to an order appropriated to each plant, as is seen in the several kinds of grains and of grasses.

In which enumeration, what we have first to notice is, unity of purpose under variety of expedients. Nothing can be more *single* than the design; more *diversified* than the means. Pellicles, shells, pulps, pods, husks, skin, scales armed with thorns, are all employed in prosecuting the same intention. Secondly; we may observe, that, in all these cases, the purpose is fulfilled within a just and *limited* degree. We can perceive, that if the seeds of plants were more strongly guarded than they are, their greater security would interfere with other uses. Many species of animals would suffer, and many perish, if they could not obtain access to them. The plant would overrun the soil; or the seed be wasted

peach-stone. After the kernel is perfected, the stone becomes hard, and the vessels cease their functions. But the substance surrounding the stone is not then thrown away as useless. That which was before only an instrument for perfecting the kernel, now receives and retains to itself the whole of the sun's influence, and thereby becomes a grateful food to man. Also what an evident mark of design is the stone protecting the kernel! The intervention of the stone prevents the second use from interfering with the first."—*Note of the Author.*

for want of room to sow itself. It is sometimes as necessary to destroy particular species of plants, as it is, at other times, to encourage their growth. Here, as in many cases, a balance is to be maintained between opposite uses. The provisions for the preservation of seeds appear to be directed chiefly against the inconstancy of the elements, or the sweeping destruction of inclement seasons. The depredation of animals, and the injuries of accidental violence, are allowed for in the abundance of the increase. The result is, that out of the many thousand different plants which cover the earth, not a single species, perhaps, has been lost since the creation.

When nature has perfected her seeds, her next care is to disperse them. The seed cannot answer its purpose while it remains confined in the capsule. After the seeds therefore are ripened, the pericarpium opens to let them out; and the opening is not like an accidental bursting, but, for the most part, is according to a certain rule in each plant. What I have always thought very extraordinary, nuts and shells, which we can hardly crack with our teeth, divide and make way for the little tender sprout, which proceeds from the kernel. Handling the nut, I could hardly conceive how the plantule was ever to get out of it. There are cases, it is said, in which the seed-vessel, by an elastic jerk, at the moment of its explosion, casts the seeds to a distance. We all however know, that many seeds (those of most composite flowers, as of the thistle, dandelion, &c.) are endowed with what are not improperly called *wings;* that is, downy appendages, by which they are enabled to float in the air, and are carried oftentimes by the wind to great distances from the plant which produces them. It is the swelling also of this downy tuft within the seed-vessel that seems to overcome the resistance of its coats, and to open a passage for the seed to escape.

But the *constitution* of seeds is still more admirable than either their preservation or their dispersion. In the body of the seed of every species of plant, or nearly of every one, provision is made for two grand purposes:

first, for the safety of the *germ;* secondly, for the temporary support of the future plant. The sprout, as folded up in the seed, is delicate and brittle beyond any other substance. It cannot be touched without being broken. Yet, in beans, peas, grass-seeds, grain, fruits, it is so fenced on all sides, so shut up and protected, that, whilst the seed itself is rudely handled, tossed into sacks, shovelled into heaps, the sacred particle, the miniature plant, remains unhurt. It is wonderful how long many kinds of seeds, by the help of their integuments, and perhaps of their oils, stand out against decay. A grain of mustard-seed has been known to lie in the earth for a hundred years; and, as soon as it had acquired a favourable situation, to shoot as vigorously as if just gathered from the plant. Then, as to the second point, the temporary support of the future plant, the matter stands thus. In grain, and pulse, and kernels, and pippins, the germ composes a very small part of the seed. The rest consists of a nutritious substance, from which the sprout draws its aliment for some considerable time after it is put forth; viz., until the fibres, shot out from the other end of the seed, are able to imbibe juices from the earth, in a sufficient quantity for its demand. It is owing to this constitution, that we see seeds sprout, and the sprouts make a considerable progress, without any earth at all. It is an economy, also, in which we remark a close analogy between the seeds of plants and the eggs of animals. The same point is provided for, in the same manner, in both. In the egg, the residence of the living principle, the cicatrix, forms a very minute part of the contents. The white and the white only is expended in the formation of the chicken. The yolk, very little altered or diminished, is wrapped up in the abdomen of the young bird, when it quits the shell; and serves for its nourishment, till it have learnt to pick its own food. This perfectly resembles the first nutrition of a plant. In the plant, as well as in the animal, the structure has every character of contrivance belonging to it: in both it breaks the transition from prepared to unprepared aliment; in both, it is prospec-

tive and compensatory. In animals which suck, this intermediate nourishment is supplied by a different source.

In all subjects, the most common observations are the best, when it is their truth and strength which have made them common. There are, of this sort, *two* concerning plants, which it falls within our plan to notice. The *first* relates to, what has already been touched upon, their germination. When a grain of corn is cast into the ground, this is the change which takes place. From one end of the grain issues a green sprout; from the other, a number of white fibrous threads. How can this be explained? Why not sprouts from both ends? why not fibrous threads from both ends? To what is the difference to be referred, but to design; to the different uses which the parts are thereafter to serve; uses which discover themselves in the sequel of the process? The sprout, or plumule, struggles into the air; and becomes the plant, of which, from the first, it contained the rudiments: the fibres shoot into the earth; and thereby both fix the plant to the ground, and collect nourishment from the soil for its support. Now, what is not a little remarkable, the parts issuing from the seed take their respective directions, into whatever position the seed itself happens to be cast. If the seed be thrown into the wrongest possible position; that is, if the ends point in the ground the reverse of what they ought to do, every thing, nevertheless, goes on right. The sprout, after being pushed down a little way, makes a bend, and turns upwards; the fibres, on the contrary, after shooting at first upwards, turn down. Of this extraordinary vegetable fact, an account has lately been attempted to be given. "The plumule (it is said) is stimulated by the *air* into action, and elongates itself when it is thus most excited; the radicle is stimulated by *moisture*, and elongates itself when *it* is thus most excited. Whence one of these grows upward in quest of its adapted object, and the other downward."* Were

* Darwin's Phytologia, p. 144.

this account better verified by experiment than it is, it only shifts the contrivance. It does not disprove the contrivance; it only removes it a little farther back. Who, to use our author's own language, "*adapted* the objects?" Who gave such a quality to these connate parts, as to be susceptible of *different* "stimulation;" as to be "excited" each only by its own element, and precisely by that which the success of the vegetation requires? I say, "which the success of the vegetation requires:" for the toil of the husbandman would have been in vain, his laborious and expensive preparation of the ground in vain; if the event must, after all, depend upon the position in which the scattered seed was sown. Not one seed out of a hundred would fall in a right direction.

Our *second* observation is upon a general property of climbing plants, which is strictly mechanical. In these plants, from each knot or joint, or, as botanists call it, axilla, of the plant, issue, close to each other, two shoots, one bearing the flower and fruit, the other drawn out into a wire, a long, tapering, spiral tendril, that twists itself round anything which lies within its reach. Considering that in this class two purposes are to be provided for (and together), fructification and support, the fruitage of the plant and the sustentation of the stalk, what means could be used more effectual, or, as I have said, more mechanical, than what this structure presents to our eyes? Why, or how, without a view to this double purpose, do two shoots, of such different and appropriate forms, spring from the same joint, from contiguous points of the same stalk? It never happens thus in robust plants, or in trees. "We see not," says Ray, "so much as one tree, or shrub, or herb, that hath a firm and strong stem, and that is able to mount up and stand alone without assistance, *furnished with these tendrils.*" Make only so simple a comparison as that between a pea and a bean. Why does the pea put forth tendrils, the bean not? but because the stalk of the pea cannot support itself, the stalk of the bean can. We may add also, as a circumstance not to be over-

looked, that, in the pea tribe, these clasps do not make their appearance till they are wanted—till the plant has grown to a height to stand in need of support.

This word "support" suggests to us a reflection upon a property of grasses, of corn, and canes. The hollow stems of these classes of plants are set at certain intervals with joints. These joints are not found in the trunks of trees, or in the solid stalks of plants. There may be other uses of these joints; but the fact is, and it appears to be at least one purpose designed by them, that they *corroborate* the stem, which by its length and hollowness would otherwise be too liable to break or bend.

Grasses are Nature's care. With these she clothes the earth—with these she sustains its inhabitants. Cattle feed upon their leaves—birds upon their smaller seeds—men upon the larger; for few readers need be told that the plants which produce our bread corn belong to this class. In those tribes which are more generally considered as grasses, their extraordinary means and powers of preservation and increase, their hardiness, their almost unconquerable disposition to spread, their faculties of reviviscence, coincide with the intention of Nature concerning them. They thrive under a treatment by which other plants are destroyed. The more their leaves are consumed, the more their roots increase. The more they are trampled upon, the thicker they grow. Many of the seemingly dry and dead leaves of grasses revive, and renew their verdure in the spring.[36] In lofty mountains, where the summer heats are not sufficient to ripen the seeds, grasses abound which are viviparous, and consequently able to propagate themselves without seed. It is an observation likewise which has often been made, that herbivorous animals attach themselves to the leaves of grasses, and if at liberty in their pastures to range

[36] Here, to be correct, we should read "Many grasses whose leaves are so dry and withered that the plants appear dead, revive and renew their existence in the spring by pushing forth new leaves from the bosom of the former ones."

and choose, leave untouched the straws which support the flowers.*

The GENERAL properties of vegetable nature, or properties common to large portions of that kingdom, are almost all which the compass of our argument allows us to bring forward. It is impossible to follow plants into their several species. We may be allowed, however, to single out three or four of these species as worthy of a particular notice, either by some singular mechanism, or by some peculiar provision, or by both.

I. In Dr. Darwin's 'Botanic Garden' (l. 395, note) is the following account of the *vallisneria*, as it has been observed in the river Rhone:—"They have roots at the bottom of the Rhone. The flowers of the *female plant* float on the surface of the water, and are furnished with an *elastic spiral stalk*, which extends or contracts as the water rises or falls—this rise or fall, from the torrents which flow into the river, often amounting to many feet in a few hours. The flowers of the *male plant* are produced under water; and as soon as the fecundating farina is mature, they separate themselves from the plant, rise to the surface, and are wafted by the air, or borne by the currents, to the female flowers." Our attention in this narrative will be directed to two particulars: first, to the mechanism, the "elastic spiral stalk," which lengthens or contracts itself according as the water rises or falls: secondly, to the provision which is made for bringing the male flower, which is produced *under* water, to the female flower, which floats upon the surface.

II. My second example I take from Withering's 'Arrangement,' vol. ii. p. 209, ed. 3. "The *Cuscuta Europæa* is a parasitical plant. The seed opens, and puts forth a *little spiral body*, which does *not* seek the earth to take root, but *climbs* in a spiral direction, from right to left, up other plants, from which, by means of vessels, it draws its nourishment." The "little spiral body" proceeding from the seed is to be compared with the fibres which seeds send out in ordinary cases; and the

* Withering, Bot. Arr., vol. i. p. 28, ed. 2nd.

comparison ought to regard both the form of the threads and the direction. They are straight; this is spiral. They shoot downwards; this points upwards. In the rule and in the exception we equally perceive design.[37]

[37] This statement is incorrect. When the seed of cuscuta opens, it puts forth a little thread-shaped body, namely, a young root, which, as in other plants, plunges into the earth, and from the opposite end elevates a young and slender stem. The latter, after a little while, applies itself to some neighbouring plant, and emits very short broad suckers on the side of its stem, which is placed in contact with the other plant: by these suckers it fastens itself upon the new branch, round which it twines, and as soon as it is secure in its new station its root perishes, and it ceases to have any communication with the earth. This property in the cuscuta seems to be given it in consequence of its root not having the power that such parts usually possess of branching, lengthening, and attracting nutriment from the earth. If the cuscuta seed germinates at a distance from any living branch to which it can adhere, it elevates its stem for a short time in the air and then dies. If it is so placed as to be able to come in contact only with dead branches, still it dies; and it is only when it succeeds in fixing itself upon a living branch that it

III. A better known parasitical plant is the evergreen shrub, called the *misseltoe*. What we have to remark in it is a singular instance of *compensation*. No art hath yet made these plants take root in the earth. Here, therefore, might seem to be a mortal defect in their constitution. Let us examine how this defect is made up to them. The seeds are endued with an adhesive quality so tenacious, that, if they be rubbed upon the smooth bark of almost any tree, they will stick to it. And then what follows? Roots, springing from these seeds, insinuate their fibres into the woody substance of the tree; and the event is, that a misseltoe plant is produced next winter.* Of no other plant do the roots refuse to shoot in the ground; of no other plant do the seeds possess this adhesive, generative quality, when applied to the bark of trees.[38]

IV. Another instance of the *compensatory* system is in the autumnal crocus, or meadow saffron (*colchicum autumnale*). I have pitied this poor plant a thousand times. Its blossom rises out of the ground in the most forlorn condition possible; without a sheath, a fence, a calyx, or even a leaf to protect it: and that, not in the spring not to be visited by summer suns, but under all the disadvantages of the declining year. When we come, however, to look more closely into the structure of this plant, we find that, instead of its being neglected, Nature has gone out of her course to provide for its security, and to make up to it for all its defects. The seed-vessel, which in other plants is situated within the cup of the flower, or just beneath it, in this plant lies

emits its suckers and continues to exist. Once attached to the living stem of another plant, it takes that for its base, and turning round once or twice, then darts forth in a straight line, touches something else which it also fixes in its folds, and thus travels from plant to plant, sometimes covering a very considerable extent of bushes.

[38] These statements are true, not only of the misseltoe or *viscum actum*, but of the whole natural order *Loranthaceæ*, with one exception.

* Withering, Bot. Arr., vol. i. p. 203, ed. 2nd.

buried ten or twelve inches underground within the bulbous root. The tube of the flower, which is seldom more than a few tenths of an inch long, in this plant extends down to the root. The styles in all cases reach the seed-vessel; but it is in this by an elongation unknown to any other plant. All these singularities contribute to one end. "As this plant blossoms late in the year, and probably would not have time to ripen its seeds before the access of winter, which would destroy them, Providence has contrived its structure such, that this important office may be performed at a depth in the earth out of reach of the usual effects of frost."* That is to say, in the autumn nothing is done above ground but the business of impregnation; which is an affair between the antheræ and the stigmata, and is probably soon over. The maturation of the impregnated seed, which in other plants proceeds within a capsule, exposed together with the rest of the flower to the open air, is here carried on, and during the whole winter, within the heart, as we

* Withering, ubi supra, p. 360.

may say, of the earth, that is, " out of the reach of the usual effects of frost." But then a new difficulty presents itself. Seeds, though perfected, are known not to vegetate at this depth in the earth. Our seeds, therefore, though so safely lodged, would, after all, be lost to the purpose for which all seeds are intended. Lest this should be the case, " a second admirable provision is made to raise them above the surface when they are perfected, and to sow them at a proper distance:" viz., the germ grows up *in the spring*, upon a fruit-stalk, accompanied with leaves. The seeds now, in common with those of other plants, have the benefit of the summer, and are sown upon the surface. The order of vegetation externally is this:—the plant produces its flowers in September; its leaves and fruits in the spring following.

V. I give the account of the *dionæa muscipula*, an extraordinary American plant, as some late authors have related it: but whether we be yet enough acquainted with the plant to bring every part of this account to the test of repeated and familiar observation, I am unable to say. " Its leaves are jointed, and furnished with two rows of strong prickles; their surfaces covered with a number of minute glands, which secrete a sweet liquor that allures the approach of flies. When these parts are touched by the legs of flies, the two lobes of the leaf instantly spring up, the rows of prickles lock themselves fast together, and squeeze the unwary animal to death."* Here, under a new model, we recognise the ancient plan of nature, viz., the relation of parts and provisions to one another, to a common office, and to the utility of the organized body to which they belong. The attracting syrup,[39] the rows of strong prickles, their position so as to interlock the joints of the leaves; and, what is more than the rest, that singular irritability of

[39] From this account must be omitted what is said of the syrup that allures the approach of flies. There is no such attraction upon the leaves of the dionæa.

* Smellie's Phil. of Nat. Hist., vol. i. p. 5.

their surfaces, by which they close at a touch ; all bear a contributory part in producing an effect, connected either with the defence or with the nutrition of the plant.[40]

[40] The pitcher-plant, *nepenthes distillatoria*, of the East, is another example which may be given. It grows natural pitchers or tankards, holding from a pint to a quart of pure water. Even when raised in this country under glass, they have been known to hold half-a-pint. The plate repre-

sents these, with their lids AA, which move on hinges, opening in moist weather, and shutting quite close in dry to prevent evaporation. When the pitcher becomes full, and requires additional support, the hook A behind the lid seizes

on some neighbouring tendril, and holds by it. BB are young pitchers just unfolding. This water which supplies the pitchers is secreted by the process of vegetation, and is perfectly pure, though the plant grows in a muddy and unwholesome marsh.

The *palo de vaca*, or cow-tree of South America. yields a delicious and nutritive milk on its trunk being pierced; and it grows in the most parched soil, and in a climate where rain is unknown during half the year.

The supply of fine water afforded by the *tillandsia* or water-with in Jamaica, and by the bejuco or *cissus latifolia* in the East, on cutting, is a fact of the same class. The latter plant also twines round other trees, and affords, as it were, a reservoir for their use.

CHAPTER XXI.

THE ELEMENTS.

When we come to the elements, we take leave of our mechanics; because we come to those things, of the organization of which, if they be organized, we are confessedly ignorant. This ignorance is implied by their name. To say the truth, our investigations are stopped long before we arrive at this point. But then it is for our comfort to find, that a knowledge of the constitution of the elements is not necessary for us. For instance, as Addison has well observed, "we know *water* sufficiently, when we know how to boil, how to freeze, how to evaporate, how to make it fresh, how to make it run or spout out, in what quantity and direction we please, without knowing what water is." The observation of this excellent writer has more propriety in it now, than it had at the time it was made; for the constitution and the constituent parts of water appear in some measure to have been lately discovered; yet it does not, I think, appear, that we can make any better or greater use of water since the discovery than we did before it.

We can never think of the elements, without reflecting upon the number of distinct uses which are *consolidated* in the same substance. The *air* supplies the lungs, supports fire, conveys sound, reflects light, diffuses smells, gives rain, wafts ships, bears up birds. Ἐξ ὕδατος τα παντα: *water*, besides maintaining its own inhabitants, is the universal nourisher of plants, and through them of terrestrial animals; is the basis of their juices and fluids; dilutes their food; quenches their thirst; floats their burdens. *Fire* warms, dissolves, enlightens: is the great promoter of vegetation and life, if not necessary to the support of both.

We might enlarge, to almost any length we please, upon each of these uses; but it appears to me almost sufficient to state them. The few remarks, which I judge it necessary to add, are as follow:—

I. Air is essentially different from earth. There appears to be no necessity for an atmosphere's investing our globe; yet it does invest it: and we see how many, how various, and how important are the purposes which it answers to every order of animated, not to say of organized, beings, which are placed upon the terrestrial surface. I think that every one of these uses will be understood upon the first mention of them, except it be that of *reflecting* light, which may be explained thus:—If I had the power of seeing only by means of rays coming directly from the sun, whenever I turned my back upon the luminary, I should find myself in darkness. If I had the power of seeing by reflected light, yet by means only of light reflected from solid masses, these masses would shine indeed, and glisten, but it would be in the dark. The hemisphere, the sky, the world, could only be *illuminated*, as it is illuminated, by the light of the sun being from all sides, and in every direction, reflected to the eye, by particles, as numerous, as thickly scattered, and as widely diffused, as are those of the air.

Another general quality of the atmosphere is the power of evaporating fluids. The adjustment of this quality to our use is seen in its action upon the sea. In the sea, water and salt are mixed together most intimately; yet the atmosphere raises the water, and leaves the salt. Pure and fresh as drops of rain descend, they are collected from brine. If evaporation be solution (which seems to be probable), then the air dissolves the water, and not the salt. Upon whatever it be founded, the distinction is critical: so much so, that when we attempt to imitate the process by art, we must regulate our distillation with great care and nicety, or, together with the water, we get the bitterness, or at least the distastefulness, of the marine substance;—and, after all, it is owing to this original elective power in the air, that we can

effect the separation which we wish, by any art or means whatever.

By evaporation, water is carried up into the air: by the converse of evaporation, it falls down upon the earth. And how does it fall? Not by the clouds being all at once re-converted into water, and descending like a sheet; not in rushing down in columns from a spout; but in moderate drops, as from a colander. Our waterings pots are made to imitate showers of rain. Yet, *à priori*, I should have thought either of the two former methods more likely to have taken place than the last.

By respiration, flame, putrefaction, air is rendered unfit for the support of animal life. By the constant operation of these corrupting principles, the whole atmosphere, if there were no restoring causes, would come at length to be deprived of its necessary degree of purity. Some of these causes seem to have been discovered, and their efficacy ascertained by experiment; and so far as the discovery has proceeded, it opens to us a beautiful and a wonderful economy. *Vegetation* proves to be one of them. A sprig of mint, corked up with a small portion of foul air, placed in the light, renders it again capable of supporting light or flame. Here, therefore, is a constant circulation of benefits maintained between the two great provinces of organized nature. The plant purifies what the animal has poisoned; in return, the contaminated air is more than ordinarily nutritious to the plant.[41] *Agitation with water* turns out to be ano-

[41] The experiments of Priestley, confirmed by those of Ingenhouz and Saussure, led to the conclusion that the air is kept pure by the action of plants, these emitting more oxygen gas by day than carbonic acid gas by night. Some doubt was thrown upon this point by the experiments of Mr. Ellis; but these appear to have been removed by Sir H. Davy's remarks and experiments. It seems probable that the plant, growing in the light, decomposes both the carbonic acid which exists, though in a very small proportion, in the atmosphere, and also any that may exist in the water applied to its leaves; for Sennebier found that when these are immersed in water impregnated with carbonic acid, oxygen

ther of these restoratives. The foulest air, shaken in a bottle with water for a sufficient length of time, recovers

gas was evolved, but not if water was used which had been boiled.

The process of vegetation appears to be the great means of supplying the loss of oxygen in the atmosphere; indeed, none other have been as yet discovered. The composition of the atmosphere, in respect of purity, though at one time supposed to vary in different places, is now ascertained to be everywhere invariably the same. It contains about 20 parts of oxygen gas, by measure, in 100, and the remaining 80 are almost entirely nitrogen gas. The only variation is in the slight portion of carbonic acid gas, which never exceeds 1 in 100, and is seldom more than 1 in 1000, supposing the circulation of the air to be unconfined. But the proportion of oxygen to the whole bulk has been found to be the same at nearly 22,000 feet high, and in the deepest valleys; the same in countries widely remote from each other, and differing in climate as well as soil; the same in the most pestilential marshes, or in hospitals, and in the most open and healthy situations. The agitation of the air by winds speedily mixes all its strata, and prevents the effects of breathing and burning from being perceived. Yet a constant consumption of oxygen is going on, wherever there are either living creatures of the hot-blooded class, or fires of any kind, natural or artificial; and this is so balanced by the process of vegetation, that the uniformity of the air's composition is maintained universally.

The union in which the oxygenous and nitrogenous portions of the atmosphere exist, also merits attention. It is ascertained to be of a peculiar kind; for it is not merely that of mechanical admixture—the union of aggregation—inasmuch as the nitrogen gas, being about a seventh part lighter than the oxygen, would rise to the top, and so make the air of higher elevations more pure, contrary to the fact. Nor is it like most other chemical unions, inasmuch as it is both extremely feeble, and is formed without any diminution in the bulk of the two substances combined together. But the kind of union in which the two gases are held is productive of the most beneficial effects. Their disengagement from each other is so easily accomplished, that there is the greatest facility in supporting flame and respiration; while

a great degree of its purity.[42] Here then again, allowing for the scale upon which nature works, we see the salutary effects of *storms* and *tempests*. The yesty waves which confound the heaven and the sea, are doing the very thing which was done in the bottle. Nothing can be of greater importance to the living creation, than the salubrity of their atmosphere. It ought to reconcile us, therefore, to the agitations of these elements, of which we sometimes deplore the consequences, to know that they tend powerfully to restore to the air that purity which so many causes are constantly impairing.

II. In Water, what ought not a little to be admired, are those negative qualities which constitute its *purity*. Had it been vinous, or oleaginous, or acid; had the sea been filled, or the rivers flowed, with wine or milk, fish, constituted as they are, must have died; plants, constituted as they are, would have withered; the lives of animals which feed upon plants must have perished. Its very *insipidity*, which is one of those negative qualities, renders it the best of all menstrua. Having no taste of its own, it becomes the sincere vehicle of every other. Had there been a taste in water, be it what it might, it would have infected every thing we ate or drank, with an importunate repetition of the same flavour.

Another thing in this element, not less to be admired, is the constant *round* which it travels; and by which, without suffering either adulteration or waste, it is con-

their mixture is so perfect, that the mischiefs are prevented which would arise from their being exhibited either to the lungs or to heated bodies in their pure state.

[42] That agitation with water will remove certain impurities in the air is undeniable, but not all impurities. Animals by breathing consume the oxygen, leaving carbonic acid gas and nitrogen gas. Water absorbs the former easily, and bulk for bulk; but of the latter it will only absorb $1\frac{1}{2}$ per cent. So of the products of putrefaction, (beside carbonic acid,) carburetted hydrogen, and sulphuretted hydrogen gases, water will absorb of the latter bulk for bulk, but not above $1\frac{2}{3}$ per cent. of the former.

tinually offering itself to the wants of the habitable globe. From the sea are exhaled those vapours which form the clouds: these clouds descend in showers, which, penetrating into the crevices of the hills, supply springs; which springs flow in little streams into the valleys; and there uniting, become rivers; which rivers, in return, feed the ocean. So there is an incessant circulation of the same fluid; and not one drop probably more or less now than there was at the creation. A particle of water takes its departure from the surface of the sea, in order to fulfil certain important offices to the earth; and having executed the service which was assigned to it, returns to the bosom which it left.

Some have thought that we have too much water upon the globe, the sea occupying above three-quarters of its whole surface. But the expanse of ocean, immense as it is, may be no more than sufficient to fertilize the earth. Or, independently of this reason, I know not why the sea may not have as good a right to its place as the land. It may proportionably support as many inhabitants; minister to as large an aggregate of enjoyment. The land only affords a habitable surface; the sea is habitable to a great depth.

III. Of Fire, we have said that it *dissolves*. The only idea probably which this term raised in the reader's mind, was that of fire melting metals, resins, and some other substances, fluxing ores, running glass, and assisting us in many of our operations, chemical or culinary. Now these are only uses of an occasional kind, and give us a very imperfect notion of what fire does for us. The grand importance of this dissolving power, the great office indeed of fire in the economy of nature, is keeping things in a state of solution—that is to say, in a state of fluidity. Were it not for the presence of heat, or of a certain degree of it, all fluids would be frozen. The ocean itself would be a quarry of ice; universal nature stiff and dead.

We see, therefore, that the elements bear not only a strict relation to the constitution of organized bodies, but

a relation to each other. Water could not perform its office to the earth without air; nor exist, as water, without fire.[43]

IV. Of Light (whether we regard it as of the same substance with fire, or as a different substance), it is altogether superfluous to expatiate upon the use. No man disputes it. The observations, therefore, which I shall offer, respect that little which we seem to know of its constitution.

Light travels from the sun at the rate of twelve millions of miles in a minute. Urged by such a velocity, with what *force* must its particles drive against (I will not say the eye, the tenderest of animal substances, but) every substance, animate or inanimate, which stands in its way! It might seem to be a force sufficient to shatter to atoms the hardest bodies.

How then is this effect, the consequence of such prodigious velocity, guarded against? By a proportionable *minuteness* of the particles of which light is composed. It is impossible for the human mind to imagine to itself any thing so small as a particle of light. But this extreme exility, though difficult to conceive, it is easy to prove. A drop of tallow, expended in the wick of a

[43] The conducting powers of different substances are beautifully adapted to the wants of the animal and vegetable kingdom. Snow is so bad a conductor, that it protects the ground effectually in rigorous climates. It is said that in Siberia there have been known to be as many as 38 degrees (Fahrenheit) of difference between the temperature of the air and that of the ground under the snow; the latter not being cooled much below the freezing point. So, too, the animal which, transported to warmer climates, becomes covered with hair, has in its own cold country a woolly covering, and this conducts heat so slowly as to accumulate that which respiration is continually producing.

The peculiarity which distinguishes water from other fluids in freezing, likewise merits attention. It expands, instead of continuing to contract, when cooled to the freezing point; and this has the useful effect of crumbling earth and even rocks, so as to render them fit for assisting the process of vegetation.

farthing candle, shall send forth rays sufficient to fill a hemisphere of a mile diameter; and to fill it so full of these rays, that an aperture not larger than the pupil of an eye, wherever it be placed within the hemisphere, shall be sure to receive some of them. What floods of light are continually poured from the sun, we cannot estimate: but the immensity of the sphere which is filled with particles, even if it reached no farther than the orbit of the earth, we can in some sort compute; and we have reason to believe, that, throughout this whole region, the particles of light lie, in latitude at least, near to one another. The spissitude of the sun's rays at the earth is such, that the number which falls upon a burning-glass of an inch diameter, is sufficient, when concentrated, to set wood on fire.

The tenuity and the velocity of particles of light, as ascertained by separate observations, may be said to be proportioned to each other, both surpassing our utmost stretch of comprehension; but proportioned. And it is this proportion alone which converts a tremendous element into a welcome visiter.

It has been observed to me by a learned friend, as having often struck his mind, that, if light had been made by a common artist, it would have been of one uniform *colour:* whereas, by its present composition, we have that variety of colours which is of such infinite use to us for the distinguishing of objects; which adds so much to the beauty of the earth, and augments the stock of our innocent pleasures.

With which may be joined another reflection, viz.—that, considering light as compounded of rays of seven different colours (of which there can be no doubt, because it can be resolved into these rays by simply passing it through a prism), the constituent parts must be well mixed and blended together, to produce a fluid so clear and colourless as a beam of light is, when received from the sun.[44]

[44] The substitution of the undulatory for the atomic theory of light would produce no alteration whatever in the author's conclusions; and, so far from diminishing, would rather in-

crease the astonishment which the phenomena of Optics are calculated to excite. The same may be said of the discoveries made partly since Dr. Paley's time, partly immediately before the composition of his work, of the two other kinds of rays which accompany those of light; the *calorific*, or heat-making, which partly mix with the *colorific*, or colour-making, of the spectrum, and partly fall beyond the least refrangible rays; and the *chemical*, which affect certain metallic salts, without either producing illumination or exciting heat, and which are to be found among and beyond the most refrangible rays: So that a beam of white light consists of three kinds of ray, and one of these kinds consists of seven subdivisions, at least according to the Newtonian theory, which divides the colours into seven instead of innumerable gradations of shades.

CHAPTER XXII.

ASTRONOMY.*

My opinion of Astronomy has always been that it is *not* the best medium through which to prove the agency of an intelligent Creator; but that, this being proved, it shows, beyond all other sciences, the magnificence of his operations. The mind which is once convinced, it raises to sublimer views of the Deity than any other subject affords; but it is not so well adapted as some other subjects are to the purpose of argument. We are destitute of the means of examining the constitution of the heavenly bodies. The very simplicity of their appearance is against them. We see nothing but bright points, luminous circles, or the phases of spheres reflecting the light which falls upon them. Now we deduce design from relation, aptitude, and correspondence of *parts*. Some degree, therefore, of *complexity* is necessary to render a subject fit for this species of argument. But the heavenly bodies do not, except perhaps in the instance of Saturn's ring, present themselves to our observation as compounded of parts at all. This, which may be a perfection in them, is a disadvantage to us, as inquirers

* For the articles of this chapter marked with an asterisk, I am indebted to some obliging communications received (through the hands of the Lord Bishop of Elphin) from the Rev. J. Brinkley, M.A., Andrew's Professor of Astronomy in the University of Dublin.—(*Note of the Author.*)—[Professor Brinkley was afterwards, as is well known, Bishop of Cloyne. His lordship, upon being made acquainted with the plan of the present publication, kindly communicated the notes now added, and which are marked with his name.]

after their nature. They do not come within our mechanics.

And what we say of their forms is true of their *motions*. Their motions are carried on without any sensible intermediate apparatus; whereby we are cut off from one principal ground of argumentation—analogy. We have nothing wherewith to compare them; no invention, no discovery, no operation or resource of art, which, in this respect, resembles them. Even those things which are made to imitate and represent them —such as orreries, planetaria, celestial globes, &c.—bear no affinity to them, in the cause and principle by which their motions are actuated. I can assign for this difference a reason of utility—*viz.*, a reason why, though the action of *terrestrial* bodies upon each other be, in almost all cases, through the intervention of solid or fluid substances, yet central attraction does not operate in this manner. It was necessary that the intervals between the planetary orbs should be devoid of any *inert* matter, either fluid or solid, because such an intervening substance would, by its resistance, destroy those very motions which attraction is employed to preserve. This may be a final cause of the difference; but still the difference destroys the analogy.

Our ignorance, moreover, of the *sensitive* natures by which other planets are inhabited, necessarily keeps from us the knowledge of numberless utilities, relations, and subserviencies, which we perceive upon our own globe.

After all, the real subject of admiration is, that we understand so much of astronomy as we do. That an animal confined to the surface of one of the planets; bearing a less proportion to it than the smallest microscopic insect does to the plant it lives upon; that this little, busy, inquisitive creature, by the use of senses which were given to it for its domestic necessities, and by means of the assistance of those senses which it has had the art to procure, should have been enabled to observe the whole system of worlds to which its own belongs; the changes of place of the immense globes

which compose it; and with such accuracy as to mark out beforehand the situation in the heavens in which they will be found at any future point of time; and that these bodies, after sailing through regions of void and trackless space, should arrive at the place where they were expected, not within a minute, but within a few seconds of a minute, of the time prefixed and predicted: all this is wonderful, whether we refer our admiration to the constancy of the heavenly motions themselves, or to the perspicacity and precision with which they have been noticed by mankind. Nor is this the whole, nor indeed the chief part, of what astronomy teaches. By bringing reason to bear upon observation (the acutest reasoning upon the exactest observation), the astronomer has been able, out of the "mystic dance," and the confusion (for such it is) under which the motions of the heavenly bodies present themselves to the eye of a mere gazer upon the skies, to elicit their order and their real paths.

Our knowledge, therefore, of astronomy is admirable, though imperfect; and, amidst the confessed desiderata and desideranda, which impede our investigation of the wisdom of the Deity in these the grandest of his works, there are to be found, in the phenomena, ascertained circumstances and laws, sufficient to indicate an intellectual agency in three of its principal operations, viz., in choosing, in determining, in regulating; in *choosing*, out of a boundless variety of suppositions which were equally possible, that which is beneficial; in *determining* what, left to itself, had a thousand chances against conveniency, for one in its favour; in *regulating* subjects, as to quantity and degree, which, by their nature, were unlimited with respect to either. It will be our business to offer, under each of these heads, a few instances, such as best admit of a popular explication.[45]

[45] This cut represents a telescopic view of the Sun, showing some of the remarkable spots which have occasionally appeared on its surface, the largest sometimes exceeding the

I. Amongst proofs of choice, one is, fixing the source of light and heat in the *centre* of the system. The sun is ignited and luminous; the planets, which move round him, are cold and dark. There seems to be no antecedent necessity for this order. The sun might have been an opaque mass; some one, or two, or more, or any, or all, the planets, globes of fire. There is nothing in the nature of the heavenly bodies which requires that those which are stationary should be on fire, that those which

size of the whole Earth. Astronomers, by closely observing the motion which these spots have across the Sun's disc, and the perspective changes which they undergo in assuming a

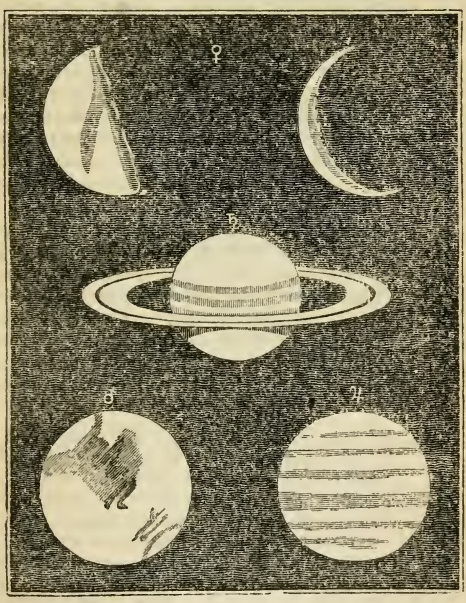
foreshortened, or oval form, as they approach his edge, previous to their disappearance, have greatly assisted the reasoning, which proves his form to be spherical, and that he has a rotation on his axis.

move should be cold; for, in fact, comets are bodies on fire, or at least capable of the most intense heat, yet revolve round a centre: nor does this order obtain between the primary planets and their secondaries, which are all opaque. When we consider, therefore, that the sun is one; that the planets going round it are, at least, seven; that it is indifferent to their nature which are luminous and which are opaque: and also in what order, with respect to each other, these two kinds of bodies are disposed; we may judge of the improbability of the present arrangement taking place by chance.

If, by way of accounting for the state in which we find the solar system, it be alleged (and this is one amongst the guesses of those who reject an intelligent Creator), that the planets themselves are only cooled or cooling masses, and were once, like the sun, many thousand times hotter than red hot iron; then it follows, that the sun also himself must be in his progress towards growing cold; which puts an end to the possibility of his having existed as he is from eternity. This consequence arises out of the hypothesis with still more certainty, if we make a part of it, what the philosophers who maintain it have usually taught, that the planets were originally masses of matter, struck off in a state of fusion, from the body of the sun, by the percussion of a comet, or by a shock from some other cause, with which we are not acquainted: for, if these masses, partaking of the nature and substance of the sun's body, have in process of time lost their heat, that body itself, in time likewise, no matter in how much longer time, must lose its heat also, and therefore be incapable of an eternal duration in the state in which we see it, either for the time to come, or the time past.

The preference of the present to any other mode of distributing luminous and opaque bodies, I take to be evident. It requires more astronomy than I am able to lay before the reader to show, in its particulars, what would be the effect to the system, of a dark body at the centre and one of the planets being luminous: but I think it manifest, without either plates or calculation,

first, that supposing the necessary proportion of magnitude between the central and the revolving bodies to be preserved, the ignited planet would not be sufficient to illuminate and warm the rest of the system; secondly, that its light and heat would be imparted to the other planets much more irregularly than light and heat are now received from the sun.[46]



[46] This cut represents the four great planets, as seen through telescopes of considerable powers. Each planet is marked by the symbol which astronomers have for ages been accustomed to use. ♄ is Saturn with his two rings; which are huge bodies, the larger having a diameter more than 25 times that of our earth, or above 200,000 miles, and moving with

(*) II. Another thing, in which a choice appears to be exercised, and in which, amongst the possibilities out of which the choice was to be made, the number of those which were wrong bore an infinite proportion to the number of those which were right, is in what geometricians call the *axis of rotation*. This matter I will endeavour to explain. The earth, it is well known, is not an exact globe, but an oblate spheroid, something like an orange. Now the axes of rotation, or the diameters upon which such a body may be made to turn round, are as many as can be drawn through its centre to opposite points upon its whole surface; but of these axes none are *permanent*, except either its shortest diameter, *i. e.* that which passes through the heart of the orange from the place where the stalk is inserted into it, and which is but one; or its longest diameters, at right angles with the former, which must all terminate in the single circumference which goes round the thickest part of the orange. The shortest diameter is that upon which in fact the earth turns, and it is, as the reader sees, what it ought to be, a permanent axis; whereas, had blind chance, had a casual impulse, had a stroke or push at random, set the earth a-spinning, the odds were infinite but that they had sent it round upon a wrong axis. And what would have been the consequence?

prodigious swiftness round the planet. The seven satellites, or moons, are not represented. ♃ is Jupiter with his spots or belts; his four moons are not represented. Both Saturn and Jupiter are, like our earth, flattened at the poles, instead of being perfect spheres, owing to their rotatory motion on their axes. ♂ is Mars, with his singularly-formed spots, and reddish light at his poles. ♀ is two figures of Venus, as she is seen in different positions; one like a half-moon, and in the other like a crescent. These *appearances* are called *phases*, from the Greek, and she is the brightest of all the planets. The bulk of Jupiter is 1281 times greater than that of the Earth, of Saturn 995 times; while that of Venus is nine-tenths and that of Mars one-half the Earth's bulk. The bulk of the Sun itself is 1,367,000 times that of the Earth.

The difference between a permanent axis and another axis is this: When a spheroid in a state of rotatory motion gets upon a permanent axis, it keeps there; it remains steady and faithful to its position: its poles preserve their direction with respect to the plane and to the centre of its orbit: but, whilst it turns upon an axis which is *not* permanent (and the number of those we have seen infinitely exceeds the number of the other), it is always liable to shift and vacillate from one axis to another, with a corresponding change in the inclination of its poles. Therefore, if a planet once set off revolving upon any other than its shortest, or one of its longest axes, the poles on its surface would keep perpetually changing, and it never would attain a permanent axis of rotation. The effect of this unfixedness and instability would be, that the equatorial parts of the earth might become the polar, or the polar the equatorial; to the utter destruction of plants and animals, which are not capable of interchanging their situations, but are respectively adapted to their own. As to ourselves, instead of rejoicing in our temperate zone, and annually preparing for the moderate vicissitude, or rather the agreeable succession, of seasons, which we experience and expect, we might come to be locked up in the ice and darkness of the arctic circle, with bodies neither inured to its rigours, nor provided with shelter or defence against them. Nor would it be much better, if the trepidation of our pole, taking an opposite course, should place us under the heats of a vertical sun. But if it would fare so ill with the human inhabitant, who can live under greater varieties of latitude than any other animal; still more noxious would this translation of climate have proved to life in the rest of the creation, and, most perhaps of all, in plants. The habitable earth, and its beautiful variety, might have been destroyed by a simple mischance in the axis of rotation.[47]

[47] (Note of Bishop Brinkley.) Either the earth was created a solid, an oblate spheroid, as it now exists, or it must have

(*) III. All this, however, proceeds upon a supposition of the earth having been formed at first an oblate

taken its present form while a soft or fluid mass. In the former case, the argument for design arising from the body revolving on a permanent axis of rotation is of the strongest possible nature. But the present extended knowledge of geology has rendered it highly probable that the earth was originally an ignited mass in a state of fluidity, ignited to the very surface, and by its rotation in that state took its present form as the result of the mutual attraction of its parts and of its rotatory motion. This must be conceded if we do not admit the choice of a permanent axis of rotation. It is, therefore, in the progress through countless ages of the changes on the surface, from the chaotic or primary formation of the geologists to the most interesting state of the surface as it now exists, that we trace the endless arguments for design. However difficult at first sight to be explained, these changes will, when understood, show *one uniform* system, in which all things work together for good.

If we consider the state of the surface before its cooling in a great degree, it must have been wholly unfitted for animal and vegetable life. The admission of this state necessarily lets in the *posterior* and *successive* creation of vegetables and animals. From the vestiges which remain we may conclude, with the highest degree of probability, that for a very long period the surface was only adapted for vegetables and the lowest description of animal life; afterwards for animals of an amphibious nature, and such as could exist only on the marshy shores of lakes, or in places occasionally covered with water. By degrees this state of the surface gave way to others more fitted for a further supply of animals *to be created.* The principal origin of these changes appears to have been provided in the powers attached to the substances, of whatever nature they may be, existing in the interior of the earth; but these powers have been merely mechanical, and could not originate organized vegetables and animals. The class of changes at the surface, constituting the tertiary formations of the geologist, appear to have been that which was followed by the introduction of a great variety of large animals, many of which are now extinct. The surface was still to be further improved by making it fitted for a wide extension of animals and of their food. This has been done

spheroid. There is another supposition; and perhaps our limited information will not enable us to decide between them. The second supposition is, that the earth, being a mixed mass somewhat fluid, took, as it might do, its present form, by the joint action of the mutual gravitation of its parts and its rotatory motion. This, as we have said, is a point in the history of the earth, which our observations are not sufficient to determine. For a very small depth below the surface (but extremely small—less, perhaps, than an eight-thousandth part, compared with the depth of the centre), we find vestiges of ancient fluidity. But this fluidity must have gone down many hundred times farther than we can penetrate, to enable the earth to take its present oblate form; and whether ny traces of this kind exist to that depth we are ignorant. Calculations were made a few years ago of the mean density of the earth, by comparing the force of its attraction with the force of attraction of a rock of granite, the bulk of which could be ascertained: and the upshot of the calculation was, that the earth upon an average, through its whole sphere, has twice the density of gra-

by the means afforded for the extension and spreading of alluvial matter, so admirably adapted for the growth of plants, and therefore for the existence of animal life. The changes of surface which have been alluded to are all parts of the same design. Between the successive changes great intervals appear to have elapsed. The imagination is able to form no conception of the length of time since the chaotic state began to change. Notwithstanding the time that must have existed between each change, one uniform plan can be discerned. The animals which we must admit to have been *successively* created, show, by their organization, the same creator. Thus, if we admit the fluid and chaotic state of the earth (the alternative if we do not admit an original spheroidal formation), there cannot be a question as to the powerful arguments to be derived from the change on the surface and its series of organized beings. Indeed, if the matter be well considered, it will appear to many that the most conclusive arguments for design and *continued* superintendence may be deduced from the researches of the modern geologists.—See Second Note to Chap. xxv. *infra.*

nite, or above five times that of water. Therefore it cannot be a hollow shell, as some have formerly supposed; nor can its internal parts be occupied by central fire or by water. The solid parts must greatly exceed the fluid parts: and the probability is, that it is a solid mass throughout, composed of substances more ponderous the deeper we go. Nevertheless, we may conceive the present face of the earth to have originated from the revolution of a sphere covered by a surface of a compound mixture; the fluid and solid parts separating, as the surface becomes quiescent. Here then comes in the *moderating* hand of the Creator. If the water had exceeded its present proportion, even but by a trifling quantity, compared with the whole globe, all the land would have been covered: had there been much less than there is, there would not have been enough to fertilize the continent. Had the exsiccation been progressive, such as we may suppose to have been produced by an evaporating heat, how came it to stop at the point at which we see it? Why did it not stop sooner? why at all? The mandate of the Deity will account for this; nothing else will.

IV. Of centripetal forces. By virtue of the simplest law that can be imagined, viz., that a body *continues* in the state in which it is, whether of motion or rest; and, if in motion, goes on in the line in which it was proceeding, and with the same velocity, *unless* there be some cause for change: by virtue, I say, of this law, it comes to pass (what may appear to be a strange consequence), that cases arise, in which attraction, incessantly drawing a body towards a centre, never brings, nor ever will bring, the body to that centre, but keep it in eternal circulation round it. If it were possible to fire off a cannon-ball with a velocity of five miles in a second, and the resistance of the air could be taken away, the cannon-ball would for ever wheel round the earth instead of falling down upon it. This is the principle which sustains the heavenly motions. The Deity having appointed this law to matter (than which, as we have said before, no law could be more simple) has turned it to a wonderful account in constructing planetary systems.

The actuating cause in these systems is an attraction which varies reciprocally as the square of the distance; that is, at double the distance, has a quarter of the force; at half the distance, four times the strength; and so on. Now concerning this law of variation, we have three things to observe: first, that attraction, for any thing we know about it, was just as capable of one law of variation as of another; secondly, that, out of an infinite number of possible laws, those which were admissible for the purpose of supporting the heavenly motions lay within certain narrow limits; thirdly, that of the admissible laws, or those which come within the limits prescribed, the law that actually prevails is the most beneficial. So far as these propositions can be made out, we may be said, I think, to prove *choice*, and *regulation:* choice, out of boundless variety; and regulation, of that which, by its own nature, was, in respect of the property regulated, indifferent and indefinite.

I. First, then, attraction, for anything we know about it, was originally indifferent to all laws of variation depending upon change of distance, *i. e.*, just as susceptible of one law as of another. It might have been the same at all distances; it might have increased as the distance increased: or it might have diminished with the increase of the distance, yet in ten thousand different proportions from the present; it might have followed no stated law at all. If attraction be what Cotes, with many other Newtonians, thought it to be, a primordial property of matter, not dependent upon, or traceable to, any other material cause; then, by the very nature and definition of a primordial property, it stood indifferent to all laws. If it be the agency of something immaterial; then also, for anything we know of it, it was indifferent to all laws. If the revolution of bodies round a centre depend upon vortices, neither are these limited to one law more than another.[48]

[48] The notion of gravitation being a quality inherent in matter, and which could not be separated from its other qualities, has long been abandoned. To argue that it is

There is, I know, an account given of attraction, which should seem, in its very cause, to assign to it the law which we find it to observe; and which, therefore, makes that law a law not of choice, but of necessity; and it is the account which ascribes attraction to an *emanation* from the attracting body. It is probable, that the influence of such an emanation will be proportioned to the spissitude of the rays of which it is composed; which spissitude, supposing the rays to issue in right lines on all sides from a point, will be reciprocally as the square of the distance. The mathematics of this solution we do not call in question: the question with us is, whether there be any sufficient reason for believing that attraction is produced by an emanation. For my part, I

necessarily inherent never could be consistent with the most ordinary perception of the meaning affixed to the terms necessary and contingent. All that could really be intended, therefore, is what we have just now stated in the first sentence of this note. But that, too, appears wholly groundless. The only appearance of a reason was derived from the intensity of all streams of matter proceeding from a centre in every direction being weakened in proportion to their diffusion, and their diffusion being proportioned to the squares of the distance (by similar triangles and the property of the circle, and generally of similar figures). But suppose we overlook the purely hypothetical nature of the connexion between such emanations and gravitation (sanctioned as the theory in a certain degree seems to be by no less an authority than *Laplace, Méc. Cél.* liv. xv. c. 1), and admit the hypothesis that matter, according to its present constitution in other respects, must have gravitation in the inverse duplicate ratio; though an important position may be thus gained or granted in Natural Philosophy, nothing whatever is effected in Natural Theology; for the same power which endowed matter with those qualities from whence this peculiar kind of attractive force results, is only proved to have created that attractive force and bestowed it upon matter mediately instead of immediately. This, in short, is only another instance of the argument formerly adverted to under the head of "Instinct," Chap. xviii., and which we there stated to be of general application.

am totally at a loss to comprehend how particles streaming *from* a centre should draw a body *towards* it. The impulse, if impulse it be, is all the other way. Nor shall we find less difficulty in conceiving a conflux of particles, incessantly flowing to a centre, and carrying down all bodies along with it, that centre also itself being in a state of rapid motion through absolute space; for, by what source is the stream fed, or what becomes of the accumulation? Add to which, that it seems to imply a contrariety of properties, to suppose an ætherial fluid to *act*, but not to *resist;* powerful enough to carry down bodies with great force towards a centre, yet, inconsistently with the nature of inert matter, powerless and perfectly yielding with respect to the motions which result from the projectile impulse. By calculations drawn from ancient notices of eclipses of the moon, we can prove that, if such a fluid exist at all, its resistance has had no sensible effect upon the moon's motion for two thousand five hundred years. The truth is, that, except this one circumstance of the variation of the attracting force at different distances agreeing with the variation of the spissitude, there is no reason whatever to support the hypothesis of an emanation; and, as it seems to me, almost insuperable reasons against it.[49]

(*) II. Our second proposition is, that, whilst the possible laws of variation were infinite, the *admissible* laws, or the laws compatible with the preservation of the system, lie within narrow limits. If the attracting force had varied according to any *direct* law of the distance, let it have been what it would, great destruction and confusion would have taken place. The direct simple proportion of the distance would, it is true, have produced an ellipse; but the perturbing forces would have acted with so much advantage, as to be continually changing the dimensions of the ellipse in a manner in-

[49] See notes 52 and 54, pp. 100, 106, where Bishop Brinkley delivers an opinion entitled, undoubtedly, to the greatest respect, but which seems somewhat more decided than the facts as yet warrant, in favour of the ætherial fluid.

consistent with our terrestrial creation. For instance; if the planet Saturn, so large and so remote, had attracted the earth, both in proportion to the quantity of matter contained in it, which it does, and also in any proportion to its distance, *i. e.* if it had pulled the harder for being the farther off (instead of the reverse of it), it would have dragged out of its course the globe which we inhabit, and have perplexed its motions, to a degree incompatible with our security, our enjoyments, and probably our existence. Of the *inverse* laws, if the centripetal force had changed as the cube of the distance, or in any higher proportion, that is (for I speak to the unlearned), if, at double the distance, the attractive force had been diminished to an eighth part, or to less than that, the consequence would have been that the planets, if they once began to approach the sun, would have fallen into his body; if they once, though by ever so little, increased their distance from the centre, would for ever have receded from it. The laws, therefore, of attraction, by which a system of revolving bodies could be upholden in their motions, lie within narrow limits compared with the possible laws. I much under-rate the restriction when I say that, in a scale of a mile, they are confined to an inch. All direct ratios of the distance are excluded on account of danger from perturbing forces:[50] all reciprocal ratios, except what lie beneath

[50] It has been objected to this statement, and the one above, that such a result would not inevitably happen from planets in any number attracting each other with forces increasing in the direct ratio of their distances, as, indeed, Sir Isaac Newton has shown ('Principia,' lib. i., prop. 64) how they would revolve in equal times and in elliptical orbits (see also the 10th and 58th propositions). In truth, all motion in elliptical orbits is connected with an increase of the force in the direct ratio of the radius vector, if the centre of the figure be the centre of forces, of which Bishop Brinkley must have been, of course, aware—(See p. 93). But if the statement in the text be taken to include the action of other bodies and systems, on the supposition that the attraction is universal,—which, it must be remembered,

the cube of the distance, by the demonstrable consequence that every the least change of distance would, under the operation of such laws, have been fatal to the repose and order of the system. We do not know, that is, we seldom reflect, how interested we are in this matter. Small irregularities may be endured; but, changes within these limits being allowed for, the permanency of our ellipse is a question of life and death to our whole sensitive world.

(*) III. That the subsisting law of attraction falls within the limits which utility requires, when these limits bear so small a proportion to the range of possibilities upon which chance might equally have cast it, is not, with any appearance of reason, to be accounted for, by any other cause than a regulation proceeding from a designing mind. But our next proposition carries the matter somewhat farther. We say, in the third place, that, out of the different laws which lie within the limits of admissible laws, the *best* is made choice of; that there are advantages in this particular law which cannot be demonstrated to belong to any other law; and, concerning some of which, it can be demonstrated that they do not belong to any other.

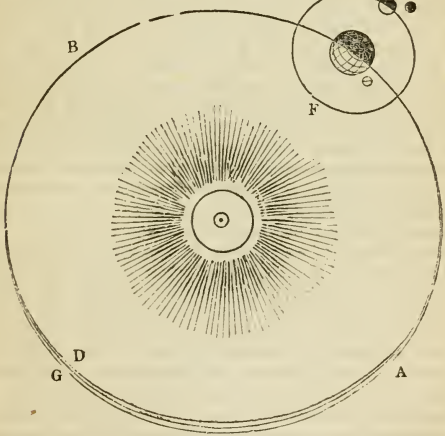
(*) 1. Whilst this law prevails between each particle of matter, the *united* attraction of a sphere, composed of that matter, observes the same law. This property of the law is necessary, to render it applicable to a system composed of spheres, but it is a property which belongs to no other law of attraction that is admissible. The law of variation of the united attraction is in no other case the same as the law of attraction of each particle, one case excepted, and that is of the attraction varying directly as the distance; the inconveniency of which law, in other respects, we have already noticed.

is involved in the very hypothesis of its increasing with the distance,—there seems no solid objection to this part, at least, of the observation; for a rushing together of all the systems, the solar and those of the fixed stars, would be the consequence of the attraction increasing according to any power of the distance, while those systems had no motion of projection.

We may follow this regulation somewhat farther, and still more strikingly perceive that it proceeded from a designing mind. A law both admissible and convenient was requisite. In what way is the law of the attracting globes obtained? Astronomical observations and terrestrial experiments show that the attraction of the globes of the system is made up of the attraction of their parts; the attraction of each globe being compounded of the attractions of its parts. Now the admissible and convenient law which exists, could not be obtained in a system of bodies gravitating by the united gravitation of their parts, unless each particle of matter were attracted by a force varying by one particular law, *viz.* varying inversely as the square of the distance: for, if the action of the particles be according to any other law whatever, the admissible and convenient law, which is adopted, could not be obtained. Here then are clearly shown regulation and design. A law both admissible and convenient was to be obtained; the mode chosen for obtaining that law was by making *each* particle of matter act. After this choice was made, then further attention was to be given to each particle of matter, and one and one only particular law of action to be assigned to it. No other law would have answered the purpose intended.

(*) 2. All systems must be liable to *perturbations*. And therefore, to guard against these perturbations, or rather to guard against their running to destructive lengths, is perhaps the strongest evidence of care and foresight that can be given. Now, we are able to demonstrate of our law of attraction, what can be demonstrated of no other, and what qualifies the dangers which arise from cross but unavoidable influences; that the action of the parts of our system upon one another will not cause permanently increasing irregularities, but merely periodical or vibratory ones; that is, they will come to a limit, and then go back again. This we can demonstrate only of a system, in which the following properties concur, *viz.* that the force shall be inversely as the square of the distance; the masses of the revolving bodies small, compared with that of the body at the centre; the orbits not

much inclined to one another; and their eccentricity little. In such a system, the grand points are secure. The mean distances and periodic times, upon which depend our temperature, and the regularity of our year, are constant. The eccentricities, it is true, will still vary; but so slowly, and to so small an extent, as to produce no inconveniency from fluctuation of temperature and season. The same as to the obliquity of the planes of the orbits. For instance, the inclination of the ecliptic to the equator will never change above two degrees (out of ninety), and that will require many thousand years in performing.[51]



[51] This cut represents the oval A B, nearly circular, in which the Earth ⊖ moves round the Sun ⊙ in one of the foci—while the Moon, E, moves round the Earth in a similar curve, E F. These curves vary (as do the paths of all the planets and their satellites), becoming more and more bulged, till they bulge out by a certain quantity, G D, so as to be A G B, and then the curve they describe flattens constantly,

It has been rightly also remarked, that, if the great planets, Jupiter and Saturn, had moved in lower spheres,

till it becomes A D B, but never more, in consequence of the four circumstances mentioned in the text.

The celebrated proposition of Laplace, respecting the eccentricities of the planetary orbits, and their deviation from a nearly circular form,—that upon which the stability of the system mainly rests,—may be comprehended by this illustration. Suppose three vessels of different burthen sail from one port to another, and take such courses, that, multiplying the tonnage of each by the square of the deviation in miles which it makes from the straight line, or shortest distance, between the two ports, and adding the three products together, the sum is at every instant of the voyage the same—say 90—the vessels being of 10, $22\frac{1}{2}$, and 90 tons burthen, respectively. It is clear that none of them can ever deviate beyond a certain distance from the straight course, for the greatest possible deviation would be 3 miles —(the square-root of the quotient of 90 divided by the tonnage of the smallest vessel)—and this supposes neither of the other two to deviate at all; if they also had their deviations, that would make the smallest vessel's deviation so much the less. In like manner, the second vessel never could deviate more than 2, nor the largest more than 1. But these deviations would always be lessened in proportion as the other vessels deviated. If we suppose the three to start from three ports in a straight line from each other, and one port to be 64, another 81, and the third 100 miles from the port of destination, and make the condition to be, that the sums of each vessel's tonnage multiplied by the square of its deviation and the products by the sums 8, 9, and 10, respectively (the square-roots of the distances of the three ports of departure), shall be always equal to the same number, *e. g.* 90,—the case will resemble more closely the one we are illustrating; for the proposition of Laplace is, that the sum of the products of the square-roots of the transverse axes of the orbits, multiplied by the squares of the eccentricities and by the masses, is always the same (*Méc. Cél.* liv. ii. c. 7 and 8; especially s. 57, 61).

The case which we have taken, however, is only by way of illustration, and does not resemble the one in question as to particulars. Moreover, in order that all the three vessels

their influences would have had much more effect as to disturbing the planetary motions, than they now have.

may be able to obey the rule during each part of their course, we must suppose one of them to start from a point on one side of the port, and the same vessel, or another of them, to make a port different from the port of destination. This difficulty would be removed by supposing the condition to be, that the sums of the products should *never exceed* a certain amount.

In the case put it is clear that, practically speaking, no combination among the navigators could make the vessels perform their voyage according to the condition unless by two of the vessels going in the straight line and the third in a line parallel to it. Nothing but a principle acting equally on the crews of all the vessels, like gravitation, or like instinct, could keep them to the terms of the rule if they were all to deviate and to vary in their deviations. But that insects should, by some such instinct, be able to perform an operation of this kind seems quite possible. Each bee acts in the construction of its cell in this way; for it keeps to the rule accurately, and it acts in perfect concert with others; at least it acts so as to produce the effect of concert.

The theorem to which we have here alluded, as well as those two similar theorems which make the mean motions and mean longitudes of the three first satellites of Jupiter follow a certain fixed rule, the difference between thrice the motions and longitudes of the second, and the motions and longitudes of the first added to twice those of the third, being an invariable quantity (that is, 0 in the case of the motions, and 180 degrees in the case of the longitudes), are all deducible by strict mathematical reasoning, but from data which are not necessarily true; for these theorems depend, among other things, upon the motions of revolution throughout the system being in the same direction. Laplace has expressed an opinion, that the relation just mentioned as to Jupiter's satellites was not the same when the motion began, but was established by the mutual actions of these bodies, which he has shown were sufficient to establish the relation at first, as well as to maintain it afterwards. This may or it may not be; that is, it may or it may not be true that those relations were established in the course of the system's action; but no kind of argument arises from hence

While they revolve at so great distances from the rest, they act almost equally on the sun and on the inferior planets; which has nearly the same consequence as not acting at all upon either.

If it be said, that the planets might have been sent round the sun in exact circles, in which case, no change of distance from the centre taking place, the law of variation of the attracting power would have never come in question, one law would have served as well as another; an answer to the scheme may be drawn from the consideration of these same perturbing forces. The system retaining in other respects its present constitution, though the planets had been at first sent round in exact circular orbits, they could not have kept them: and if the law of attraction had not been what it is, or at least, if the prevailing law had transgressed the limits above assigned, every evagation would have been fatal: the planet once drawn, as drawn it necessarily must have been, out of its course, would have wandered in endless error.[52]

against the designing power, even if we admit the supposition of that great mathematician; for then it would only follow that the same principle which was appointed to preserve had also been appointed to create the relation of stability. (See *Méc. Cél.* liv. ii. c. 8, s. 66; liv. viii. c. 6, s. 15, and c. 10, s. 29. See also Mrs. Somerville's truly profound and admirable work, *Mechanism of the Heavens*, b. iv. c. 1, s. 849, *et seq.*)

[52] (Note of Bishop Brinkley.) Many suppose attraction an emanation, and the law of attraction (the inverse square of the distance) which exists, to be actually *necessary* and deducible from *equal* quantities of the attractive force being spread over each spherical surface surrounding the attractive centre. If this were so, all attracting matter must act according to the same law. This is not the case in many instances that might be adduced. The attraction by which particles of matter adhere together is obviously not of this nature. Chemical action furnishes many exceptions to this law. It may, indeed, be said that a polarizing power may be joined to an attractive force acting as abovementioned. We

(*) V. What we have seen in the law of the centripetal force, *viz.* a choice guided by views of utility, and a choice of one law out of thousands which might equally have taken place, we see no less in the *figures* of the planetary orbits. It was not enough to fix the law of the centripetal force, though by the wisest choice; for, even under that law, it was still competent to the planets to have moved in paths possessing so great a degree of eccentricity, as, in the course of every revolution, to be brought very near to the sun, and carried away to immense distances from him. The comets actually move in orbits of this sort; and, had the planets done so, instead of going round in orbits nearly circular, the change from one extremity of temperature to another must, in ours at least, have destroyed every animal and plant upon its surface. Now the distance from the centre at which a planet sets off, and the absolute force of attraction at that distance, being fixed, the figure of its orbit, its being a circle, or nearer to, or farther off from a circle, *viz.* a rounder or a longer oval, depends upon two things, the velocity with which, and the direction in which, the planet is projected. And these, in order to produce a right result, must be both brought within certain narrow limits. One, and only one, velocity, united with one, and only one, direction, will produce a perfect circle. And the velocity must be near to this velocity, and the direction also near to this direction, to produce

know very imperfectly, or rather nothing, of the nature of this polarization; but we know it is not extended to the actions of the sun and planetary masses on each other. Why was it not extended to these? The simple answer is, that it would not only have been useless, but it would have interfered with the purposes for which these bodies were designed. Thus these great bodies are moved by laws of the utmost simplicity, while their component parts act on each other by a combination of forces of various kinds; which forces appear to act at small distances only, while the forces on which depend the welfare and preservation of our earth and the planets, act through a vast extent of space, and by one simple and uniform law, in which there is no conflicting interference of other actions.

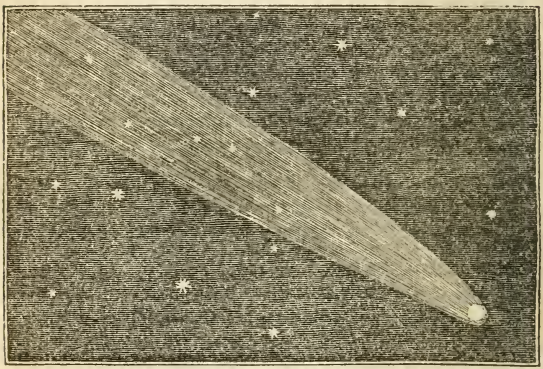
orbits, such as the planetary orbits are, nearly circular; that is, ellipses with small eccentricities. The velocity and the direction must *both* be right. If the velocity be wrong, no direction will cure the error; if the direction be in any considerable degree oblique, no velocity will produce the orbit required. Take, for example, the attraction of gravity at the surface of the earth. The force of that attraction being what it is, out of all the degrees of velocity, swift and slow, with which a ball might be shot off, none would answer the purpose of which we are speaking, but what was nearly that of five miles in a second. If it were less than that, the body would not get round at all, but would come to the ground; if it were in any considerable degree more than that, the body would take one of those eccentric courses, those long ellipses, of which we have noticed the inconveniency. If the velocity reached the rate of seven miles in a second, or went beyond that, the ball would fly off from the earth, and never be heard of more. In like manner with respect to the *direction;* out of the innumerable angles in which the ball might be sent off (I mean angles formed with a line drawn in the centre), none would serve but what was nearly a right one: out of the various directions in which the cannon might be pointed, upwards and downwards, every one would fail, but what was exactly or nearly horizontal. The same thing holds true of the planets: of our own amongst the rest. We are entitled therefore to ask, and to urge the question, Why did the projectile velocity and projectile direction of the earth happen to be nearly those which would retain it in a *circular* form? Why not one of the infinite number of velocities, one of the infinite number of directions, which would have made it approach much nearer to, or recede much farther from, the sun?

The planets going round, all in the same direction, and all nearly in the same plane, afforded to Buffon a ground for asserting, that they had all been shivered from the sun by the same stroke of a comet, and by that stroke projected into their present orbits. Now, beside that this is to attribute to chance the fortunate concur-

rence of velocity and direction which we have been here noticing, the hypothesis, as I apprehend, is inconsistent with the physical laws by which the heavenly motions are governed. If the planets were struck off from the surface of the sun, they would return to the surface of the sun again. Nor will this difficulty be got rid of, by supposing that the same violent blow which shattered the sun's surface, and separated large fragments from it, pushed the sun himself out of his place; for, the consequence of this would be that the sun and system of shattered fragments would have a progressive motion, which, indeed, may possibly be the case with our system; but then each fragment would, in every revolution, return to the surface of the sun again. The hypothesis is also contradicted by the vast difference which subsists between the *diameters* of the planetary orbits. The distance of Saturn from the sun (to say nothing of the Georgium Sidus) is nearly five-and-twenty times that of Mercury; a disparity which it seems impossible to reconcile with Buffon's scheme. Bodies starting from the same place, with whatever difference of direction or velocity they set off, could not have been found at these different distances from the centre, still retaining their nearly circular orbits. They must have been carried to their proper distances, before they were projected.*

* "If we suppose the matter of the system to be accumulated in the centre by its gravity, *no* mechanical principles, with the assistance of this power of gravity, could separate the vast mass into such parts as the sun and planets; and, after carrying them to their different distances, project them in their several directions, preserving still the quality of action and re-action, or the state of the centre of gravity of the system. Such an exquisite structure of things could only arise from the contrivance and powerful influences of an intelligent, free, and most potent agent. The same powers, therefore, which, at present, govern the material universe, and conduct its various motions, are *very different* from those which were necessary to have produced it from nothing, or to have disposed it in the admirable form in which it now proceeds."—*Maclaurin's Account of Newton's Philosophy*, p. 407, ed. 3.

To conclude: In astronomy, the great thing is to raise the imagination to the subject, and that oftentimes in opposition to the impression made upon the senses. An illusion, for example, must be gotten over arising from the distance at which we view the heavenly bodies, *viz.* the apparent *slowness* of their motions.[53] The moon



[53] This cut represents the comet of 1811, the fixed stars being seen through its tail, which extended 123,000,000 of miles. The period of its revolution is calculated at above 3,300 years. The great comet of 1680 was calculated by Sir Isaac Newton to have a tail of 80,000,000 of miles, immediately after its perihelion, a periodic time of 575 years, and a velocity, when nearest the sun, of 880,000 miles in an hour. Its orbit is so much elongated that its greatest distance from the sun is estimated at near 3,000 millions of miles, and its least at only 150,000 miles. Halley's comet, which appeared in 1682, 1759, and 1835,—probably also in 1531 and 1607,—has a mean distance from the sun of 1,705 millions of miles, the earth's mean distance being 96,000,000; but while the earth's orbit is so nearly circular that the planet's greatest distance is only a thirtieth part more than its smallest, this comet's aphelion (or greatest) distance is above 3,355 millions, and its perihelion (or least) distance

shall take some hours in getting half a yard from a star which it touched. A motion so deliberate we may think easily guided. But what is the fact? The moon, in fact, is, all this while, driving through the heavens at the rate of considerably more than two thousand miles in an hour; which is more than double of that with which a ball is shot off from the mouth of a cannon. Yet is this prodigious rapidity as much under government, as if the planet proceeded ever so slowly, or were conducted in its course inch by inch. It is also difficult to bring the imagination to conceive (what yet, to judge tolerably of the matter, it is necessary to conceive) how *loose*, if we may so express it, the heavenly bodies are. Enormous globes, held by nothing, confined by nothing, are turned into free and boundless space, each to seek its course by the virtue of an invisible principle; but a principle, one, common, and the same in all, and ascertainable. To preserve such bodies from being lost, from running together in heaps, from hindering and distracting one another's motions, in a degree inconsistent with any continuing order; *h. e.* to cause them to form planetary systems, systems that, when formed, can be upheld, and, most especially, systems accommodated to the organised and sensitive natures, which the planets sustain, as we know to be the case, where alone we can know what the case is, upon our earth: all this requires an intelligent interposition, because it can be demonstrated concerning it, that it requires an adjustment of force,

only 55 millions, or sixty-one times less. So the transverse (or longer) axis of its orbit is four times the length of the conjugate (or shorter) axis; whereas the two axes of the earth's orbit differ by only a 7000th part from one another. Most of the planetary orbits are nearly circular also, that of Pallas being the most elongated, and in the proportion of only 5 to 3. But the orbits of the comets have every variety of shape as well as size, and their motion the greatest difference in velocity; yet they appear all to follow the same general laws, and these the same by which the planetary motions are governed.

distance, direction, and velocity, out of the reach of chance to have produced; an adjustment, in its view to utility, similar to that which we see in ten thousand subjects of nature which are nearer to us, but in power, and in the extent of space through which that power is exerted, stupendous.[54]

[54] (Note of Bishop Brinkley. See Note 49.) Since the publication of Dr. Paley's 'Natural Theology' it has been ascertained that a resisting medium is actually diffused through our system. But it is of so rare a nature, that the planets will not be affected by it for an immense period. The existence of this resisting medium has been ascertained by the successive revolutions of the small comet, the orbit of which was first accurately computed by M. Encke, and its identity verified on several successive returns. We had before a knowledge of the weak action of comets on the planets, and of the consequent smallness of their masses. It was also inferred that they were bodies of small density, and consequently would be more sensibly affected in their motions through a resisting medium. This comet was found in 1795 by Miss Herschel, and observed also by her brother. His account of it, when considered with reference to what has since been ascertained as to the resistance it meets with in its course, is remarkable (vide Phil. Trans. 1796, p. 133):—"The comet is now centrically on a small star. It is a small telescopic star of about the eleventh or twelfth magnitude, and is double, very unequal: with a power of 287 I can see the smallest of the two stars perfectly well. This shows how little density there is in the comet, which is evidently nothing but what may be called a collection of vapours." This comet is also remarkable for the shortness of its period, about three and a half years, not receding so far from the sun as the planet Jupiter. In the solar system the difference between the two classes of bodies which revolve round the sun, and are retained in their orbits by the solar action, is most marked and distinct. Comets so numerous serve for purposes entirely unknown to us. Indeed, hitherto no probable conjecture has been formed as to those purposes. That they are not the habitations of beings similar to those which exist on the earth is nearly certain. The earth and planets appear wisely adapted, in a variety of ways, for the conveni-

But many of the heavenly bodies, as the sun and fixed stars, are *stationary*. Their rest must be the effect of an absence or of an equilibrium of attractions. It proves also, that a projectile impulse was originally given to some of the heavenly bodies, and not to others. But further: if attraction act at all distances, there can only be one quiescent centre of gravity in the universe; and all bodies whatever must be approaching this centre or revolving round it. According to the first of these sup-

ence and preservation of animals and vegetables. The comets are not so adapted. In one case orbits nearly circular were required, in the other they were not required.

There is another circumstance in which design appears strongly marked, although we cannot explain the purport of it. The planets appear to be placed at distances from the sun, according to a certain law. This was remarked by Professor Bode, and that the law was not complete unless a planet existed between Mars and Jupiter. The new planets were afterwards discovered, each of them circulating between Jupiter and Mars, at a distance from the sun conformable to the conjectured law.* The cause of more than one planet being found at this distance has, with some degree of probability, been derived from the hypothesis that a large planet has been shattered into fragments, which fragments are the planets Ceres, Vesta, Pallas, and Juno. That wonderful changes occasionally offer themselves to our notice, as wonderful as the destruction of a planet, is exemplified in the appearance and disappearance of a fixed star. A star suddenly appeared in 1571, of a degree of splendour exceeding all the other fixed stars. It was seen during sixteen months, and continually diminished in brightness till it disappeared. All the circumstances of it are well attested by many astronomers, and others. It remained fixed in one spot of the heavens without changing its place among the other stars by any perceptible quantity. Although astronomical instruments at that time did not admit of a degree of precision to be compared with those of the present time, yet the observations made on it by several astronomers fully suffice to show that its distance from us must have been at least between 3000 and 4000 times that of the sun from the earth, or 300,000 millions of miles.

* See first note to chap. xxv. *infra.*

positions, if the duration of the world had been long enough to allow of it, all its parts, all the great bodies of which it is composed, must have been gathered together in a heap round this point. No changes however which have been observed, afford us the smallest reason for believing that either the one supposition or the other is true: and then it will follow, that attraction itself is controlled or suspended by a superior agent; that there is a power above the highest of the powers of material nature; a will which restrains and circumscribes the operations of the most extensive.*

* It must here, however, be stated that many astronomers deny that any of the heavenly bodies are absolutely stationary. Some of the brightest of the fixed stars have certainly small motions; and of the rest the distance is too great, and the intervals of our observation too short, to enable us to pronounce with certainty that they may not have the same. The motions in the fixed stars which have been observed are considered either as proper to each of them, or as compounded of the motion of our system, and of motions proper to each star. By a comparison of these motions, a motion in our system is supposed to be discovered. By continuing this analogy to other and to all systems, it is possible to suppose that attraction is unlimited, and that the whole material universe is revolving round some fixed point within its containing sphere or space.—*Note of the Author.*

CHAPTER XXIII.

OF THE PERSONALITY OF THE DEITY.

Contrivance, if established, appears to me to prove every thing which we wish to prove. Amongst other things, it proves the *personality* of the Deity, as distinguished from what is sometimes called nature, sometimes called a principle: which terms, in the mouths of those who use them philosophically, seem to be intended to admit and to express an efficacy, but to exclude and to deny a personal agent. Now that which can contrive, which can design, must be a person. These capacities constitute personality, for they imply consciousness and thought. They require that which can perceive an end or purpose; as well as the power of providing means, and directing them to their end.* They require a centre in which perceptions unite, and from which volitions flow; which is mind. The acts of a mind prove the existence of a mind; and in whatever a mind resides, is a person. The seat of intellect is a person. We have no authority to limit the properties of mind to any particular corporeal form, or to any particular circumscription of space. These properties subsist, in created nature, under a great variety of sensible forms. Also every animated being has its *sensorium;* that is, a certain portion of space, within which perception and volition are exerted. This sphere may be enlarged to an indefinite extent; may comprehend the universe; and, being so imagined, may serve to furnish us with as good a notion as we are capable of forming, of the *immensity* of the Divine Nature, *i. e.* of a Divine Being,

* Priestley's Letters to a Philosophical Unbeliever, p. 153, ed. 2.

infinite, as well in essence as in power; yet nevertheless a person.

"No man hath seen God at any time." And this, I believe, makes the great difficulty. Now it is a difficulty which chiefly arises from our not duly estimating the state of our faculties. The Deity, it is true, is the object of none of our senses; but reflect what limited capacities animal senses are. Many animals seem to have but one sense, or perhaps two at the most; touch and taste. Ought such an animal to conclude against the existence of odours, sounds, and colours? To another species is given the sense of smelling. This is an advance in the knowledge of the powers and properties of nature: but, if this favoured animal should infer from its superiority over the class last described, that it perceived everything which was perceptible in nature, it is known to us, though perhaps not suspected by the animal itself, that it proceeded upon a false and presumptuous estimate of its faculties. To another is added the sense of hearing; which lets in a class of sensations entirely unconceived by the animal before spoken of; not only distinct, but remote from any which *it* had ever experienced, and greatly superior to them. Yet this last animal has no more ground for believing that its senses comprehend all things, and all properties of things, which exist, than might have been claimed by the tribes of animals beneath it; for we know that it is still possible to possess another sense, that of sight, which shall disclose to the percipient a new world. This fifth sense makes the animal what the human animal is: but to infer that possibility stops here; that either this fifth sense is the last sense, or that the five comprehend all existence,—is just as unwarrantable a conclusion as that which might have been made by any of the different species which possessed fewer, or even by that, if such there be, which possessed only one. The conclusion of the one-sense animal, and the conclusion of the five-sense animal, stand upon the same authority. There may be more and other senses than those which we have. There may be senses suited to

the perception of the powers, properties, and substance, of spirits. These may belong to higher orders of rational agents; for there is not the smallest reason for supposing that we are the highest, or that the scale of creation stops with us.

The great *energies* of nature are known to us only by their effects. The substances which produce them are as much concealed from our senses as the Divine essence itself. *Gravitation*, though constantly present, though constantly exerting its influence, though everywhere around us, near us, and within us; though diffused throughout all space, and penetrating the texture of all bodies with which we are acquainted, depends, if upon a fluid, upon a fluid which, though both powerful and universal in its operation, is no object of sense to us; if upon any other kind of substance or action, upon a substance and action from which *we* receive no distinguishable impressions. Is it then to be wondered at that it should, in some measure, be the same with the Divine nature?

Of this, however, we are certain, that whatever the Deity be, neither the *universe*, nor any part of it which we see, can be He. The universe itself is merely a collective name: its parts are all which are real; or which are *things*. Now inert matter is out of the question; and organized substances include marks of contrivance. But whatever includes marks of contrivance, whatever, in its constitution, testifies design, necessarily carries us to something beyond itself, to some other being, to a designer prior to, and out of itself. No animal, for instance, can have contrived its own limbs and senses: can have been the author to itself of the design with which they were constructed. That supposition involves all the absurdity of self-creation, *i. e.* of acting without existing. Nothing can be God, which is ordered by a wisdom and a will, which itself is void of; which is indebted for any of its properties to contrivance *ab extra*. The *not* having that in his nature which requires the exertion of another prior being (which property is sometimes called self-sufficiency, and sometimes self-compre-

hension) appertains to the Deity, as his essential distinction, and removes his nature from that of all things which we see. Which consideration contains the answer to a question that has sometimes been asked, namely, Why, since something or other must have existed from eternity, may not the present universe be that something? The contrivance perceived in it proves that to be impossible. Nothing contrived can, in a strict and proper sense, be eternal, forasmuch as the contriver must have existed before the contrivance.

Wherever we see marks of contrivance, we are led for its cause to an *intelligent* author. And this transition of the understanding is founded upon uniform experience. We see intelligence constantly contriving; that is, we see intelligence constantly producing effects, marked and distinguished by certain properties; not certain particular properties, but by a kind and class of properties, such as relation to an end, relation of parts to one another, and to a common purpose. We see, wherever we are witnesses to the actual formation of things, nothing except intelligence producing effects so marked and distinguished. Furnished with this experience, we view the productions of nature. We observe *them* also marked and distinguished in the same manner. We wish to account for their origin. Our experience suggests a cause perfectly adequate to this account. No experience, no single instance or example, can be offered in favour of any other. In this cause, therefore, we ought to rest; in this cause the common sense of mankind has, in fact, rested, because it agrees with that, which, in all cases, is the foundation of knowledge,—the undeviating course of their experience. The reasoning is the same as that by which we conclude any ancient appearances to have been the effects of volcanoes or inundations; namely, because they resemble the effects which fire and water produce before our eyes; and because we have never known these effects to result from any other operation. And this resemblance may subsist in so many circumstances, as not to leave us under the smallest doubt in forming our opinion. Men are not deceived by this

reasoning: for whenever it happens, as it sometimes does happen, that the truth comes to be known by direct information, it turns out to be what was expected. In like manner, and upon the same foundation (which in truth is that of experience), we conclude that the works of nature proceed from intelligence and design; because, in the properties of relation to a purpose, subserviency to a use, they resemble what intelligence and design are constantly producing, and what nothing except intelligence and design ever produce at all. Of every argument, which would raise a question as to the safety of this reasoning, it may be observed, that if such argument be listened to, it leads to the inference, not only that the present order of nature is insufficient to prove the existence of an intelligent Creator, but that no imaginable order would be sufficient to prove it, that *no* contrivance, were it ever so mechanical, ever so precise, ever so clear, ever so perfectly like those which we ourselves employ, would support this conclusion—a doctrine to which I conceive no sound mind can assent.

The force, however, of the reasoning is sometimes sunk by our taking up with mere names. We have already noticed,* and we must here notice again, the misapplication of the term "law," and the mistake concerning the idea which that term expresses in physics, whenever such idea is made to take the place of power, and still more of an intelligent power, and as such, to be assigned for the cause of any thing, or of any property of any thing, that exists. This is what we are secretly apt to do, when we speak of organized bodies (plants for instance, or animals) owing their production, their form, their growth, their qualities, their beauty, their use, to any law or laws of nature; and when we are contented to sit down with that answer to our inquiries concerning them. I say once more, that it is a perversion of language to assign any law, as the efficient, operative cause of any thing. A law pre-supposes an agent, for it is only the mode according to which an agent pro-

* Chap. i. sect. vii.

ceeds; it implies a power, for it is the order according to which that power acts. Without this agent, without this power, which are both distinct from itself, the "law" does nothing; is nothing.

What has been said concerning "law," holds true of *mechanism*. Mechanism is not itself power. Mechanism, without power, can do nothing. Let a watch be contrived and constructed ever so ingeniously; be its parts ever so many, ever so complicated, ever so finely wrought or artificially put together, it cannot *go* without a weight or spring, *i. e.* without a force independent of, and ulterior to, its mechanism. The spring acting at the centre, will produce different motions and different results, according to the variety of the intermediate mechanism. One and the self-same spring, acting in one and the same manner, *viz.* by simply expanding itself, may be the cause of a hundred different and all useful movements, if a hundred different and well-devised sets of wheels be placed between it and the final effect: *e. g.* may point out the hour of the day, the day of the month, the age of the moon, the position of the planets, the cycle of the years, and many other serviceable notices; and these movements may fulfil their purposes with more or less perfection, according as the mechanism is better or worse contrived, or better or worse executed, or in a better or worse state of repair: *but in all cases it is necessary that the spring act at the centre.* The course of our reasoning upon such a subject would be this: By inspecting the watch, even when standing still, we get a proof of contrivance, and of a contriving mind, having been employed about it. In the form and obvious relation of its parts, we see enough to convince us of this. If we pull the works in pieces, for the purpose of a closer examination, we are still more fully convinced. But, when we see the watch *going*, we see proof of another point, *viz.* that there is a power somewhere, and somehow or other applied to it; a power in action;—that there is more in the subject than the mere wheels of the machine;—that there is a secret spring, or a gravitating plummet;—in a

word, that there is force, and energy, as well as mechanism.

So, then, the watch in motion establishes to the observer two conclusions: One,—that thought, contrivance, and design, have been employed in the forming, proportioning, and arranging of its parts, and that whoever or wherever he be, or were, such a contriver there is, or was: The other,—that force or power, distinct from mechanism, is, at this present time, acting upon it. If I saw a hand-mill even at rest, I should see contrivance: but if I saw it grinding, I should be assured that a hand was at the windlass, though in another room. It is the same in nature. In the works of nature we trace mechanism; and this alone proves contrivance: but living, active, moving, productive nature, proves also the exertion of a power at the centre: for, wherever the power resides may be denominated the centre.

The intervention and disposition of what are called "*second causes*" fall under the same observation. This disposition is or is not mechanism, according as we can or cannot trace it by our senses and means of examination. That is all the difference there is; and it is a difference which respects our faculties, not the things themselves. Now where the order of second causes is mechanical, what is here said of mechanism strictly applies to it. But it would be always mechanism (natural chemistry, for instance, would be mechanism), if our senses were acute enough to descry it. Neither mechanism, therefore, in the works of nature, nor the intervention of what are called second causes (for I think that they are the same thing), excuses the necessity of an agent distinct from both.

If, in tracing these causes, it be said that we find certain general properties of matter which have nothing in them that bespeaks intelligence, I answer, that still the *managing* of these properties, the pointing and directing them to the uses which we see made of them, demands intelligence in the highest degree. For example: suppose animal secretions to be elective attractions, and that such and such attractions universally belong to such

and such substances—in all which there is no intellect concerned; still the choice and collocation of these substances, the fixing upon right substances, and disposing them in right places, must be an act of intelligence. What mischief would follow were there a single transposition of the secretory organs; a single mistake in arranging the glands which compose them!

There may be many second causes, and many courses of second causes, one behind another, between what we observe of nature, and the Deity: but there must be intelligence somewhere: there must be more in nature than what we see; and, amongst the things unseen, there must be an intelligent, designing author. The philosopher beholds with astonishment the production of things around him. Unconscious particles of matter take their stations, and severally range themselves in an order, so as to become collectively plants or animals, *i. e.* organised bodies, with parts bearing strict and evident relation to one another, and to the utility of the whole: and it should seem that these particles could not move in any other way than as they do; for they testify not the smallest sign of choice, or liberty, or discretion. There may be particular intelligent beings, guiding these motions in each case: or they may be the result of trains of mechanical dispositions, fixed beforehand by an intelligent appointment, and kept in action by a power at the centre. But, in either case, there must be intelligence.

The minds of most men are fond of what they call a *principle*, and of the appearance of simplicity, in accounting for phænomena. Yet this principle, this simplicity, resides merely in the *name:* which name, after all, comprises, perhaps, under it a diversified, multifarious, or progressive operation, distinguishable into parts. The power in organised bodies, of producing bodies like themselves, is one of these principles. Give a philosopher this, and he can get on. But he does not reflect what this mode of production, this principle (if such he choose to call it) requires; how much it presupposes; what an apparatus of instruments, some of which are strictly mechanical, is necessary to its success;

what a train it includes of operations and changes, one succeeding another, one related to another, one ministering to another, all advancing, by intermediate, and, frequently, by sensible steps, to their ultimate result! Yet, because the whole of this complicated action is wrapped up in a single term, *generation*, we are to set it down as an elementary principle; and to suppose, that when we have resolved the things which we see into this principle, we have sufficiently accounted for their origin, without the necessity of a designing, intelligent Creator. The truth is, generation is not a principle, but a *process*. We might as well call the casting of metals a principle; we might, so far as appears to me, as well call spinning and weaving principles: and then, referring the texture of cloths, the fabric of muslins and calicoes, the patterns of diapers and damasks, to these, as principles, pretend to dispense with intention, thought, and contrivance, on the part of the artist; or to dispense, indeed, with the necessity of any artist at all, either in the manufacturing of the article, or in the fabrication of the machinery by which the manufacture was carried on.

And, after all, how, or in what sense is it true, that animals produce their *like?* A butterfly, with a proboscis instead of a mouth, with four wings and six legs, produces a hairy caterpillar, with jaws and teeth, and fourteen feet. A frog produces a tadpole. A black beetle, with gauze wings, and a crusty covering, produces a white, smooth, soft worm; an ephemeron fly, a cod-bait maggot. These, by a progress through different stages of life, and action, and enjoyment (and, in each state, provided with implements and organs appropriated to the temporary nature which they bear), arrive at last at the form and fashion of the parent animal. But all this is process, not principle; and proves, moreover, that the property of animated bodies, of producing their like, belongs to them, not as a primordial property, not by any blind necessity in the nature of things, but as the effect of œconomy, wisdom, and design; because the property itself assumes diversities, and submits to devi-

ations dictated by intelligible utilities, and serving distinct purposes of animal happiness.

The opinion, which would consider "generation" as a *principle* in nature; and which would assign this principle as the cause, or endeavour to satisfy our minds with such a cause, of the existence of organised bodies; is confuted, in my judgment, not only by every mark of contrivance discoverable in those bodies, for which it gives us no contriver, offers no account whatever; but also by the further consideration, that things generated possess a clear relation to things *not* generated. If it were merely one part of a generated body bearing a relation to another part of the same body; as the mouth of an animal to the throat, the throat to the stomach, the stomach to the intestines, those to the recruiting of the blood, and, by means of the blood, to the nourishment of the whole frame: or if it were only one generated body bearing a relation to another generated body; as the sexes of the same species to each other, animals of prey to their prey, herbivorous and granivorous animals to the plants or seeds upon which they feed; it might be contended, that the whole of this correspondency was attributable to generation, the common origin from which these substances proceeded. But what shall we say to agreements which exist between things generated and things *not generated?* Can it be doubted, was it ever doubted, but that the *lungs* of animals bear a relation to the *air*, as a permanently elastic fluid? They act in it, and by it; they cannot act without it. Now, if generation produced the animal, it did not produce the air: yet their properties correspond. The *eye* is made for *light*, and light for the eye. The eye would be of no use without light, and light perhaps of little without eyes; yet one is produced by generation, the other not. The *ear* depends upon *undulations* of air. Here are two sets of motions; first, of the pulses of the air; secondly, of the drum, bones, and nerves of the ear; sets of motions bearing an evident reference to each other: yet the one, and the apparatus for the one, produced by

the intervention of generation; the other altogether independent of it.

If it be said, that the air, the light, the elements, the world itself, is *generated;* I answer, that I do not comprehend the proposition. If the term mean any thing similar to what it means when applied to plants or animals, the proposition is certainly without proof: and, I think, draws as near to absurdity as any proposition can do, which does not include a contradiction in its terms. I am at a loss to conceive how the formation of the world can be compared to the generation of an animal. If the term generation signify something quite different from what it signifies on ordinary occasions, it may, by the same latitude, signify any thing. In which case, a word or phrase taken from the language of Otaheite would convey as much theory concerning the origin of the universe, as it does to talk of its being generated.

We know a cause (intelligence) adequate to the appearances which we wish to account for: we have this cause continually producing similar appearances: yet rejecting this cause, the sufficiency of which we know, and the action of which is constantly before our eyes, we are invited to resort to suppositions destitute of a single fact for their support, and confirmed by no analogy with which we are acquainted. Were it necessary to inquire into the *motives* of men's opinions, I mean their motives separate from their arguments; I should almost suspect, that, because the proof of a Deity drawn from the constitution of nature is not only popular but vulgar (which may arise from the cogency of the proof, and be indeed its highest recommendation), and because it is a species almost of *puerility* to take up with it; for these reasons, minds, which are habitually in search of invention and originality, feel a resistless inclination to strike off into other solutions and other expositions. The truth is, that many minds are not so indisposed to any thing which can be offered to them, as they are to the *flatness* of being content with common reasons: and, what is most to be lamented, minds conscious of superiority are the most liable to this repugnancy.

The "'suppositions" here alluded to all agree in one character: they all endeavour to dispense with the necessity in nature of a particular, personal intelligence; that is to say, with the exertion of an intending, contriving mind, in the structure and formation of the organised constitutions which the world contains. They would resolve all productions into *unconscious* energies, of a like kind, in that respect, with attraction, magnetism, electricity, &c.; without any thing further.

In this, the old system of atheism and the new agree. And I much doubt whether the new schemes have advanced any thing upon the old, or done more than changed the terms of the nomenclature. For instance, I could never see the difference between the antiquated system of atoms, and Buffon's organic molecules. This philosopher, having made a planet by knocking off from the sun a piece of melted glass, in consequence of the stroke of a comet; and having set it in motion, by the same stroke, both round its own axis and the sun; finds his next difficulty to be, how to bring plants and animals upon it. In order to solve this difficulty, we are to suppose the universe replenished with particles, endowed with life, but without organisation or senses of their own; and endowed also with a tendency to marshal themselves into organised forms. The concourse of these particles, by virtue of this tendency, but without intelligence, will, or direction (for I do not find that any of these qualities are ascribed to them), has produced the living forms which we now see.

Very few of the conjectures, which philosophers hazard upon these subjects, have more of pretension in them, than the challenging you to show the direct impossibility of the hypothesis. In the present example, there seemed to be a positive objection to the whole scheme upon the very face of it; which was that, if the case were as here represented, *new* combinations ought to be perpetually taking place; new plants and animals, or organised bodies which were neither, ought to be starting up before our eyes every day. For this, however, our philosopher has an answer. Whilst so many

forms of plants and animals are already in existence, and, consequently, so many "internal moulds," as he calls them, are prepared and at hand, the organic particles run into these moulds, and are employed in supplying an accession of substance to them, as well for their growth, as for their propagation. By which means, things keep their ancient course. But, says the same philosopher, should any general loss or destruction of the present constitution of organised bodies take place, the particles, for want of "moulds" into which they might enter, would run into different combinations, and replenish the waste with new species of organised substances.

Is there any history to countenance this notion? Is it known that any destruction has been so repaired? any desert thus re-peopled?

So far as I remember, the only natural appearance mentioned by our author, by way of fact whereon to build his hypothesis, is the formation of *worms* in the intestines of animals, which is here ascribed to the coalition of superabundant organic particles, floating about in the first passages; and which have combined themselves into these simple animal forms, for want of internal moulds, or of vacancies in those moulds, into which they might be received. The thing referred to is rather a species of facts, than a single fact; as some other cases may, with equal reason, be included under it. But to make it a fact at all, or, in any sort, applicable to the question, we must begin with asserting an *equivocal* generation, contrary to analogy, and without necessity: contrary to an analogy, which accompanies us to the very limits of our knowledge or inquiries; for wherever, either in plants or animals, we are able to examine the subject, we find procreation from a parent form: without necessity; for I apprehend that it is seldom difficult to suggest methods by which the eggs, or spawn, or yet invisible rudiments of these vermin, may have obtained a passage into the cavities in which they are found.* Add to this,

* I trust I may be excused for not citing, as another fact which is to confirm the hypothesis, a grave assertion of this

that their *constancy to their species*, which, I believe, is as regular in these as in the other vermes, decides the question against our philosopher, if, in truth, any question remained upon the subject.

Lastly; these wonder-working instruments, these "internal moulds," what are they after all? what, when examined, but a name without signification; unintelligible, if not self-contradictory; at the best, differing in nothing from the "essential forms" of the Greek philosophy? One short sentence of Buffon's work exhibits his scheme as follows: "When this nutritious and prolific matter, which is diffused throughout all nature, passes through the *internal mould* of an animal or vegetable, and finds a proper matrix, or receptacle, it gives rise to an animal or vegetable of the same species." Does any reader annex a meaning to the expression "internal mould," in this sentence? Ought it then to be said, that, though we have little notion of an internal mould, we have not much more of a designing mind? The very contrary of this assertion is the truth. When we speak of an artificer or an architect, we talk of what is comprehensible to our understanding, and familiar to our experience. We use no other terms, than what refer us for their meaning to our consciousness and observation; what express the constant objects of both: whereas names like that we have mentioned refer us to nothing; excite no idea; convey a sound to the ear, but I think do no more.

Another system, which has lately been brought forward, and with much ingenuity, is that of *appetencies*. The principle, and the short account of the theory, is this: Pieces of soft, ductile matter, being endued with propensities or appetencies for particular actions, would, by continual endeavours, carried on through a long series of generations, work themselves gradually into suitable forms; and, at length, acquire, though perhaps by obscure and almost imperceptible improvements, an organisation fitted to the action which their respective propensities

writer, that the branches of trees upon which the stag feeds break out again in his horns. Such *facts* merit no discussion.—(*Note of the Author.*)

led them to exert. A piece of animated matter, for example, that was endued with a propensity to *fly*, though ever so shapeless, though no other we will suppose than a round ball to begin with, would, in a course of ages, if not in a million of years, perhaps in a hundred millions of years (for our theorists, having eternity to dispose of, are never sparing in time), acquire *wings*. The same tendency to locomotion in an aquatic animal, or rather in an animated lump, which might happen to be surrounded by water, would end in the production of *fins;* in a living substance, confined to the solid earth, would put out *legs* and *feet;* or, if it took a different turn, would break the body into ringlets, and conclude by *crawling* upon the ground.

Although I have introduced the mention of this theory into this place, I am unwilling to give to it the name of an *atheistic* scheme, for two reasons: first, because, so far as I am able to understand it, the original propensities and the numberless varieties of them (so different, in this respect, from the laws of mechanical nature, which are few and simple) are, in the plan itself, attributed to the ordination and appointment of an intelligent and designing Creator: secondly, because, likewise, that large postulatum, which is all along assumed and presupposed, the faculty in living bodies of producing other bodies organised like themselves, seems to be referred to the same cause; at least is not attempted to be accounted for by any other. In one important respect, however, the theory before us coincides with atheistic systems, *viz.* in that, in the formation of plants and animals, in the structure and use of their parts, it does away final causes.[55] Instead of the parts of a plant or animal,

[55] In one sense this doctrine (if it deserve the name) of appetencies can hardly be said to supersede final causes. For suppose the *conatus* or appetency to have formed an eye, such as we now have it, and constructed as we know it to be, all its uses continue; it is calculated to perform the office required,—to supply that, the desire of supplying which is supposed to have produced it. Stating that desire caused the production, appears only to be a covert and somewhat absurd mode of stating the doctrine of final causes.

or the particular structure of the parts, having been intended for the action or the use to which we see them applied; according to this theory, they have themselves grown out of that action, sprung from that use. The theory therefore dispenses with that which we insist upon, the necessity, in each particular case, of an intelligent, designing mind, for the contriving and determining of the forms which organised bodies bear. Give our philosopher these appetencies; give him a portion of living irritable matter (a nerve, or the clipping of a nerve), to work upon: give also to his incipient or progressive forms the power, in every stage of their alteration, of propagating their like; and, if he is to be believed, he could replenish the world with all the vegetable and animal productions which we at present see in it.

The scheme under consideration is open to the same objection with other conjectures of a similar tendency, *viz.* a total defect of evidence. No changes, like those which the theory requires, have ever been observed. All the changes in Ovid's Metamorphoses might have been effected by these appetencies, if the theory were true; yet not an example, nor the pretence of an example, is offered of a single change being known to have taken place. Nor is the order of generation obedient to the principle upon which this theory is built. The mammæ* of the male have not vanished by inusitation;

* I confess myself totally at a loss to guess at the reason, either final or efficient, for this part of the animal frame; unless there be some foundation for an opinion, of which I draw the hint from a paper of Mr. Everard Home (Phil. Transact. 1799, Pt. 2), viz. that the mammæ of the fœtus may be formed before the sex is determined.[56]—(*Note of the Author.*)

[56] The paper alluded to is upon Hermaphrodites, in vol. lxxxix. p. 157, and the suggestion is in the remarks upon the want of ovaria in certain monstrous births, and the male parts being found instead. The author (Sir E. Home) suggests that this may be explained by supposing the ovum, before impregnation, to have been equally adapted to becoming either a male or a female fœtus.

nec curtorum, per multa sæcula, Judæorum propagini deest præputium. It is easy to say, and it has been said, that the alterative process is too slow to be perceived; that it has been carried on through tracts of immeasurable time; and that the present order of things is the result of a graduation, of which no human records can trace the steps. It is easy to say this; and yet it is still true, that the hypothesis remains destitute of evidence.

The *analogies* which have been alleged are of the following kind: The *bunch* of a camel is said to be no other than the effect of carrying burdens; a service in which the species has been employed from the most ancient times of the world. The first race, by the daily loading of the back, would probably find a small grumous tumour to be formed in the flesh of that part. The next progeny would bring this tumour into the world with them. The life to which they were destined would increase it. The cause which first generated the tubercle being continued, it would go on, through every succession, to augment its size, till it attained the form and the bulk under which it now appears. This may serve for one instance: another, and that also of the passive sort, is taken from certain species of birds. Birds of the *crane* kind, as the crane itself, the heron, bittern, stork, have, in general, their thighs bare of feathers. This privation is accounted for from the habit of wading in water, and from the effect of that element to check the growth of feathers upon these parts; in consequence of which, the health and vegetation of the feathers declined through each generation of the animal; the tender down, exposed to cold and wetness, became weak, and thin, and rare, till the deterioration ended in the result which we see, of absolute nakedness. I will mention a third instance, because it is drawn from an active habit, as the two last were from passive habits; and that is the *pouch* of the pelican. The description which naturalists give of this organ is as follows: "From the lower edges of the under chap hangs a bag, reaching from the whole length of the bill to the neck, which is said to be capable of containing fifteen quarts of water. This bag

the bird has a power of wrinkling up into the hollow of the under chap. When the bag is empty, it is not seen: but when the bird has fished with success, it is incredible to what an extent it is often dilated. The first thing the pelican does in fishing is to fill the bag; and then it returns to digest its burden at leisure. The bird preys upon the large fishes, and hides them by dozens in its pouch. When the bill is opened to its widest extent, a person may run his head into the bird's mouth; and conceal it in this monstrous pouch, thus adapted for very singular purposes."* Now this extraordinary conformation is nothing more, say our philosophers, than the result of habit; not of the habit or effort of a single pelican, or of a single race of pelicans, but of a habit perpetuated through a long series of generations. The pelican soon found the convenience of reserving in its mouth, when its appetite was glutted, the remainder of its prey, which is fish. The fulness produced by this attempt of course stretched the skin which lies between the under chaps, as being the most yielding part of the mouth. Every distension increased the cavity. The original bird, and many generations which succeeded him, might find difficulty enough in making the pouch answer this purpose: but future pelicans, entering upon life with a pouch derived from their progenitors, of considerable capacity, would more readily accelerate its advance to perfection, by frequently pressing down the sac with the weight of fish which it might now be made to contain.

These, or of this kind, are the analogies relied upon. Now, in the first place, the instances themselves are unauthenticated by testimony; and in theory, to say the least of them, open to great objections. Who ever read of camels without bunches, or with bunches less than those with which they are at present usually formed? A bunch, not unlike the camel's, is found between the shoulders of the buffalo; of the origin of which it is impossible to give the account here given. In the second

* Goldsmith, vol. vi. p. 52.

example: Why should the application of water, which appears to promote and thicken the growth of feathers upon the bodies and breasts of geese, and swans, and other water-fowls, have divested of this covering the thighs of cranes? The third instance, which appears to me as plausible as any that can be produced, has this against it, that it is a singularity restricted to the species; whereas, if it had its commencement in the cause and manner which have been assigned, the like conformation might be expected to take place in other birds, which fed upon fish. How comes it to pass, that the pelican alone was the inventress, and her descendants the only inheritors, of this curious resource? [57]

[57] The argument against the doctrine of *appetencies* may be urged thus upon well-known facts. If the camel's bunch has arisen from the animal, originally without any protuberance, having his back affected by burthens imposed, it would follow that human contrivance could alter the shape of beasts, which it most certainly cannot, as daily experience in regard to most domestic animals shows. No change of form produced immediately and directly, as by cutting, compressing, rubbing, can be perpetuated in the breed. All we can do with regard to animals, and all that any animals can do with regard to themselves, is indirectly, as by affecting their health, to affect the proportions of their parts, as bone, fat, muscle; the effects of which changes will be perceived in the progeny.

We have here been observing only upon the fact; but suppose the fact to be as the theory of appetencies assumes,—suppose the camel's bunch has been formed by weight and friction, and the pelican's pouch by the food distending the under chap,—in other words, suppose (contrary to what we have shown is the fact) that the changes induced in one animal or race at a given time, are propagated and continue in their descendants,—it is plain that the sceptical argument gains nothing by this concession. For how are such changes continued? Only by the process of generation. Nay, how are they at first effected? By the operation of physical laws, that is, by the constitution of matter. The quadruped's bunch and the bird's pouch, allowing the whole facts to be as the argument assumes it, are both originally formed and propagated afterwards by the means of the qualities with

But it is the less necessary to controvert the instances themselves, as it is a straining of analogy beyond all limits of reason and credibility, to assert that birds, and beasts, and fish, with all their variety and complexity of organisation, have been brought into their forms, and distinguished into their several kinds and natures, by the same process (even if that process could be demonstrated, or had it ever been actually noticed) as might seem to serve for the gradual generation of a camel's bunch, or a pelican's pouch.

The solution, when applied to the works of nature *generally*, is contradicted by many of the phænomena, and totally inadequate to others. The *ligaments* or strictures, by which the tendons are tied down at the angles of the joints, could, by no possibility, be formed by the motion or exercise of the tendons themselves; by an appetency exciting these parts into action; or by any tendency arising therefrom. The tendency is all the other way: the *conatus* in constant opposition to them. Length of time does not help the case at all, but the reverse. The *valves* also in the blood-vessels could never be formed in the manner which our theorist proposes. The blood, in its right and natural course, has no tendency to form them. When obstructed or refluent, it has the contrary. These parts could not grow out of their use, though they had eternity to grow in.

which matter is endowed; and the inference of design is not affected by the step thus added to the process of reasoning. It can manifestly make no difference to that inference, whether we hold that the bird's pouch is provided for its necessities by a conformation at all times belonging to it according to the constitution of the world, or by one superinduced according to that same constitution. The utmost that the sceptical hypothesis can gain by such concessions as we have been supposing to be made, is that the form of the world was at one time less perfect than it now is. A similar remark arises upon the conjecture of Laplace (in which others have followed him) respecting the original arrangement of the motions and longitudes of Jupiter's three first satellites, treated of in another note.—(*See notes to Chap.* xxii.)

The *senses* of animals appear to me altogether incapable of receiving the explanation of their origin which this theory affords. Including under the word "sense" the organ and the perception, we have no account of either. How will our philosopher get at *vision*, or make an eye? How should the blind animal affect sight, of which blind animals, we know, have neither conception nor desire? Affecting it, by what operation of its will, by what endeavour to see, could it so determine the fluids of its body, as to inchoate the formation of an eye? or suppose the eye formed, would the perception follow? The same of the other senses. And this objection holds its force, ascribe what you will to the hand of time, to the power of habit, to changes too slow to be observed by man, or brought within any comparison which he is able to make of past things with the present; concede what you please to these arbitrary and unattested suppositions, how will they help you? Here is no inception. No laws, no course, no powers of nature which prevail at present, nor any analogous to these, would give commencement to a new sense. And it is in vain to inquire how that might proceed, which could never *begin*.

I think the senses to be the most inconsistent with the hypothesis before us, of any part of the animal frame. But other parts are sufficiently so. The solution does not apply to the parts of animals, which have little in them of motion. If we could suppose joints and muscles to be gradually formed by action and exercise, what action or exercise could form a skull, and fill it with brains? No effort of the animal could determine the clothing of its skin. What *conatus* could give prickles to the porcupine or hedgehog, or to the sheep its fleece?

In the last place: What do these appetencies mean when applied to plants? I am not able to give a signification to the term, which can be transferred from animals to plants; or which is common to both. Yet a no less successful organisation is found in plants, than what obtains in animals. A solution is wanted for one, as well as the other.

Upon the whole, after all the schemes and struggles of a reluctant philosophy, the necessary resort is to a Deity. The marks of *design* are too strong to be gotten over. Design must have had a designer. That designer must have been a person. That person is GOD.

CHAPTER XXIV.

OF THE NATURAL ATTRIBUTES OF THE DEITY.

It is an immense conclusion, that there is a God; a perceiving, intelligent, designing Being; at the head of creation, and from whose will it proceeded. The *attributes* of such a Being, suppose his reality to be proved, must be adequate to the magnitude, extent, and multiplicity of his operations: which are not only vast beyond comparison with those performed by any other power; but, so far as respects our conceptions of them, infinite, because they are unlimited on all sides.

Yet the contemplation of a nature so exalted, however surely we arrive at the proof of its existence, overwhelms our faculties. The mind feels its powers sink under the subject. One consequence of which is, that from painful abstraction the thoughts seek relief in sensible images. Whence may be deduced the ancient, and almost universal propensity to idolatrous substitutions. They are the resources of a labouring imagination. False religions usually fall in with the natural propensity; true religions, or such as have derived themselves from the true, resist it.

It is one of the advantages of the revelations which we acknowledge, that, whilst they reject idolatry with its many pernicious accompaniments, they introduce the Deity to human apprehension, under an idea more personal, more determinate, more within its compass, than the theology of nature can do. And this they do by representing him exclusively under the relation in which he stands to ourselves; and, for the most part, under some precise character, resulting from that relation, or from the history of his providences: which method suits

the span of our intellects much better than the universality which enters into the idea of God, as deduced from the views of nature. When, therefore, these representations are well founded in point of authority (for all depends upon that), they afford a condescension to the state of our faculties, of which they, who have most reflected on the subject, will be the first to acknowledge the want and the value.

Nevertheless, if we be careful to imitate the documents of our religion, by confining our explanations to what concerns ourselves, and do not affect more precision in our ideas than the subject allows of, the several terms which are employed to denote the attributes of the Deity may be made, even in natural religion, to bear a sense consistent with truth and reason, and not surpassing our comprehension.

These terms are,—Omnipotence, omniscience, omnipresence, eternity, self-existence, necessary existence, spirituality.

"Omnipotence," "omniscience," "infinite" power, "infinite" knowledge, are *superlatives;* expressing our conception of these attributes in the strongest and most elevated terms which language supplies. We ascribe power to the Deity under the name of "omnipotence," the strict and correct conclusion being, that a power which could create such a world as this is, must be, beyond all comparison, greater than any which we experience in ourselves, than any which we observe in other visible agents; greater also than any which we can want, for our individual protection and preservation, in the Being upon whom we depend. It is a power, likewise, to which we are not authorised, by our observation or knowledge, to assign any limits of space or duration.

Very much of the same sort of remark is applicable to the term "omniscience," infinite knowledge, or infinite wisdom. In strictness of language, there is a difference between knowledge and wisdom; wisdom always supposing action, and action directed by it. With respect to the first, viz. *knowledge*, the Creator must know, intimately, the constitution and properties of the things

which he created: which seems also to imply a foreknowledge of their action upon one another, and of their changes; at least, so far as the same result from trains of physical and necessary causes. His omniscience also, as far as respects things present, is deducible from his nature, as an intelligent being, joined with the extent, or rather the universality, of his operations. Where he acts, he is: and where he is, he perceives. The *wisdom* of the Deity, as testified in the works of creation, surpasses all idea we have of wisdom, drawn from the highest intellectual operations of the highest class of intelligent beings with whom we are acquainted; and, which is of the chief importance to us, whatever be its compass or extent, which it is evidently impossible that we should be able to determine, it must be adequate to the conduct of that order of things under which we live. And this is enough. It is of very inferior consequence, by what terms we express our notion, or rather our admiration, of this attribute. The terms, which the piety and the usage of language have rendered habitual to us, may be as proper as any other. We can trace this attribute much beyond what is necessary for any conclusion to which we have occasion to apply it. The degree of knowledge and power requisite for the formation of created nature cannot, with respect to us, be distinguished from infinite.[58]

The divine "omnipresence" stands, in natural theology, upon this foundation:—In every part and place of the universe with which we are acquainted, we perceive the exertion of a power, which we believe, mediately or

[58] It is not perhaps quite correct to state that "*infinite*," as applied to the Deity, means only a degree of power or wisdom beyond all comparison greater than any such qualities possessed by ourselves; and that this term, as well as "*omnipotence*," is merely a superlative. Those words also designate the existence of the attributes in such a degree, that any extent whatever of them being either presented to our observation, or conceived by our imagination, the Deity possesses them in a still greater degree—a degree to which our conception can affix no bounds.

immediately, to proceed from the Deity. For instance: in what part or point of space, that has ever been explored, do we not discover attraction? In what regions do we not find light? In what accessible portion of our globe do we not meet with gravity, magnetism, electricity: together with the properties also and powers of organised substances, of vegetable or of animated nature? Nay, further, we may ask, What kingdom is there of nature, what corner of space, in which there is any thing that can be examined by us, where we do not fall upon contrivance and design? The only reflection perhaps which arises in our minds from this view of the world around us is, that the laws of nature everywhere prevail; that they are uniform and universal. But what do you mean by the laws of nature, or by any law? Effects are produced by power, not by laws. A law cannot execute itself. A law refers us to an agent. Now an agency so general, as that we cannot discover its absence, or assign the place in which some effect of its continued energy is not found, may, in popular language at least, and, perhaps, without much deviation from philosophical strictness, be called universal: and, with not quite the same, but with no inconsiderable propriety, the person or Being, in whom that power resides, or from whom it is derived, may be taken to be *omnipresent*. He who upholds all things by his power, may be said to be every where present.

This is called a virtual presence. There is also what metaphysicians denominate an essential ubiquity; and which idea the language of Scripture seems to favour: but the former, I think, goes as far as natural theology carries us.[59]

[59] Upon this confessedly abstruse subject some statements will be found in the Appendix. The three doctrines are—ubiquity by *diffusion, virtual* ubiquity, or that of power only, and ubiquity of *essence*. The last is expressed thus, to the exclusion of the second, by Sir I. Newton, in the Schol. Gen. to the Principia:—"Omnipræsens est non per *virtutem* solam sed etiam per *substantiam*; nam virtus sine substantiâ subsistere non potest." It is perhaps hardly correct to say

"Eternity" is a negative idea, clothed with a positive name. It supposes, in that to which it is applied, a present existence; and is the negation of a beginning or an end of that existence. As applied to the Deity, it has not been controverted by those who acknowledge a Deity at all. Most assuredly, there never was a time in which nothing existed, because that condition must have continued. The universal *blank* must have remained; nothing could rise up out of it; nothing could ever have existed since; nothing could exist now. In strictness, however, we have no concern with duration prior to that of the visible world. Upon this article therefore of theology, it is sufficient to know that the contriver necessarily existed before the contrivance.

"Self-existence" is another negative idea, viz. the negation of a preceding cause, as of a progenitor, a maker, an author, a creator.[60]

that Natural Theology carries us not to the idea of Essential Ubiquity. Dr. Clarke makes Essential Ubiquity one part of his conclusion from the argument *à priori;* and though his adversaries (see Chev. Ramsay, book i. prop. 8. Schol.) charged him with adopting the Diffusive Ubiquity, he is plainly not subject to this observation. The followers of Socinus, who maintained Virtual Ubiquity, are ably combated, and the Essential Ubiquity defended by Dr. Hancock (Boyle Lecture, vol. ii. p. 222), upon arguments drawn from natural religion. We are here, it is to be observed, only speaking of the idea or doctrine itself having been attained independent of Revelation; and not inquiring how far those arguments of unassisted reason have enforced the belief of it, or even made it comprehensible. Descartes (Principia I. xxii.) does not enumerate Ubiquity at all among the attributes, unless in so far as it may be included under infinite perfection generally ascribed.—(I. xxii. xxvii., II. xxxvi., III. i.)

[60] *Self-existent* means, in any intelligible sense, only uncreated, independent, eternal. The ancient doctrine of *Self-created*, if it goes beyond the mere negative sense, is absolutely unintelligible, or, to use Dr. Clarke's words, "an express contradiction."

"Necessary existence" means demonstrable existence.[61]

"Spirituality" expresses an idea, made up of a negative part, and of a positive part. The negative part consists in the exclusion of some of the known properties of matter, especially of solidity, of the *vis inertiæ*, and of gravitation. The positive part comprises perception, thought, will, power, *action*, by which last term is meant the origination of motion; the quality, perhaps, in which resides the essential superiority of spirit over matter, "which cannot move, unless it be moved; and cannot but move, when impelled by another."* I apprehend that there can be no difficulty in applying to the Deity both parts of this idea.

[61] *Necessary* properly means demonstrable in such a way, that the contrary involves a contradiction, and is inconceivable. Dr. Paley here uses the word demonstrable *per se* in this sense, for which he has the authority of several metaphysical writers.

* Bishop Wilkins's Principles of Natural Religion, p. 106.

CHAPTER XXV.

OF THE UNITY OF THE DEITY.

Of the "Unity of the Deity," the proof is, the *uniformity* of plan observable in the universe. The universe itself is a system; each part either depending upon other parts, or being connected with other parts by some common law of motion, or by the presence of some common substance. One principle of gravitation causes a stone to drop towards the earth, and the moon to wheel round it. One law of attraction carries all the different planets about the sun.[62] This philosophers demonstrate. There

[62] Bishop Brinkley considers the subject of nebulæ and double stars "as hardly yet sufficiently investigated" for affording grounds of additional illustration to the cultivator of Natural Theology; and it is much to be regretted that he, on this account, abandoned the design, which he says he had at one time formed, of adding some notes upon this branch of astronomical science. The Appendix will contain a reference to this subject, particularly to the additional argument drawn from the revolution of double stars in favour of the universal extension of gravitation.

The fact of the heavenly bodies which form our system all moving in the same direction of revolution, is deserving of the deepest attention when we consider that it leads to the most important result of the stability of the system explained above (chap. xxii., notes); and that it is one of innumerable arrangements which might have been made, and none of which could have led to this result. In any other case equal roots, or imaginary roots, or both, must have found their way into the equation from which the law of stability is deduced. (*Méc. Cél.* l. ii. c. 7, s. 55, 57, and liv. xv. c. 1.) Now the same profound geometrician has shown, in another work, by the calculus of probabilities, that it is above four

are also other points of agreement amongst them, which may be considered as marks of the identity of their origin and of their intelligent Author. In all are found the conveniency and stability derived from gravitation. They all experience vicissitudes of days and nights, and changes of season. They all, at least Jupiter, Mars, and Venus, have the same advantages from their atmosphere as we have. In all the planets, the axes of rotation are permanent. Nothing is more probable than that the same attracting influence, acting according to the same rule, reaches to the fixed stars: but, if this be only probable, another thing is certain, *viz.* that the same element of light does. The light from a fixed star affects our eyes in the same manner, is refracted and reflected according to the same laws, as the light of a candle. The velocity of the light of the fixed stars is also the same as the velocity of the light of the sun, reflected from the satellites of Jupiter. The heat of the

millions of millions to one in favour of the forty-three motions from west to east (including rotation as well as revolution and the motions of the sun and of the rings, as well as of the planets and satellites) having been directed by one original or First Cause; and by the same calculus he has shown the probability of the sun's rising again on the morrow of any given day, to be not much more than 1,800,000 to one, or, in other words, that this event is above two million times less probable than the truth of the position that the motions in our system were designed by one First Cause. This illustrious philosopher has been censured for not drawing in terms the conclusion to which his sublime researches, with those of Lagrange, have led the way, and at which he must himself have arrived,—that a Supreme Intelligence alone could have formed this magnificent and stable system. His reason for abstaining from indulging in such contemplations probably was that his work is purely mathematical, and that this would have been a digression into another science. But the reason is not sufficient, and the omission must ever be lamented as a defect in a work so nearly perfect. Mr. Whewell has made some ingenious strictures upon this subject in his able and learned *Bridgewater Treatise*, b. iii. c. 5 and 6.

sun, in kind, differs nothing from the heat of a coal fire.[63]

In our own globe, the case is clearer. New countries are continually discovered, but the old laws of nature are always found in them: new plants, perhaps, or animals,

[63] The law by which the distances of the planets are regulated was referred to in a note by Bishop Brinkley to the 22d chapter, and affords an evidence of unity of design not to be passed over. It is this nearly, but not exactly. Form a series of numbers, each consisting of the number 4 added to the number 3, but to the number 3 multiplied successively by 0, 1, 2, 4, 8, 16, and the other powers of 2: the mean distance of Mercury being 4, this series will represent the mean distances of the other planets successively. Taking the four newly-discovered planets between Mars and Jupiter as one—the distances of Venus, the Earth, and Jupiter, coincide with the series exactly; the others slightly differ. Thus—

Mercury by the supposition	4		4
Venus by the theory	7	by observation	7
Earth	10		10
Mars	16		15
New planets	28		27
Vesta		23·73	
Juno		26·67	
Ceres		27·67	
Pallas		27·68	
Jupiter	52		52
Saturn	100		95
Uranus	196		192

"We cannot but remark," says Bishop Brinkley, "the near agreement of the law with the exact mean distances, and cannot hesitate to pronounce that those were assigned according to a law, although we are entirely ignorant of the exact law and of the reason for that law."

This sentence derives a peculiar, though a painful interest from the circumstance of its being in all likelihood the last written by this profound and accomplished astronomer, on subjects connected with his favourite study. It closed the communication received from him, which was dated at Cloyne, June 25, 1835; and he died at Dublin in less than three months after (September 14).

but always in company with plants and animals which we already know; and always possessing many of the same general properties. We never get amongst such original, or totally different, modes of existence, as to indicate, that we are come into the province of a different Creator, or under the direction of a different will. In truth, the same order of things attends us wherever we go. The elements act upon one another, electricity operates, the tides rise and fall, the magnetic needle elects its position, in one region of the earth and sea, as well as in another. One atmosphere invests all parts of the globe, and connects all; one sun illuminates, one moon exerts its specific attraction upon all parts. If there be a variety in natural effects, as, *e. g.* in the tides of different seas, that very variety is the result of the same cause, acting under different circumstances. In many cases this is proved; in all, is probable.

The inspection and comparison of *living* forms add to this argument examples without number. Of all large terrestrial animals the structure is very much alike; their senses nearly the same; their natural functions and passions nearly the same; their viscera nearly the same, both in substance, shape, and office: digestion, nutrition, circulation, secretion, go on in a similar manner in all; the great circulating fluid is the same; for, I think, no difference has been discovered in the properties of *blood*, from whatever animal it be drawn. The experiment of transfusion proves that the blood of one animal will serve for another. The *skeletons* also of the larger terrestrial animals show particular varieties, but still under a great general affinity. The resemblance is somewhat less, yet sufficiently evident, between quadrupeds and birds. They are all alike in five respects, for one in which they differ.

In *fish*, which belong to another department, as it were, of nature, the points of comparison become fewer. But we never lose sight of our analogy: *e. g.* we still meet with a stomach, a liver, a spine; with bile and blood; with teeth; with eyes (which eyes are only slightly varied from our own, and which variation, in truth, demonstrates, not an interruption, but a continu-

ance of the same exquisite plan; for it is the adaptation of the organ to the element, *viz.* to the different refraction of light passing into the eye out of a denser medium). The provinces, also, themselves of water and earth, are connected by the species of animals which inhabit both; and also by a large tribe of aquatic animals, which closely resemble the terrestrial in their internal structure; I mean the cetaceous tribe, which have hot blood, respiring lungs, bowels, and other essential parts, like those of land-animals. This similitude, surely, bespeaks the same creation and the same Creator.

Insects and *shell-fish* appear to me to differ from other classes of animals the most widely of any. Yet even here, besides many points of particular resemblance, there exists a general relation of a peculiar kind. It is the relation of inversion; the law of contrariety: namely, that whereas, in other animals, the bones, to which the muscles are attached, lie *within* the body, in insects and shell-fish they lie on the *outside* of it. The shell of a lobster performs to the animal the office of a *bone*, by furnishing to the tendons that fixed basis or immoveable fulcrum, without which, mechanically, they could not act. The crust of an insect is its shell, and answers the like purpose. The shell also of an oyster stands in the place of a *bone;* the bases of the muscles being fixed to it, in the same manner as, in other animals, they are fixed to the bones. All which (under wonderful varieties, indeed, and adaptations of form) confesses an imitation, a remembrance, a carrying on, of the same plan.

The observations here made are equally applicable to plants; but, I think, unnecessary to be pursued. It is a very striking circumstance, and also sufficient to prove all which we contend for, that, in this part likewise of organized nature, we perceive a continuation of the *sexual* system.

Certain however it is, that the whole argument for the divine unity goes no farther than to an unity of counsel.[64]

[64] The extraordinary discoveries in geology made since Dr. Paley's time by the study of fossil osteology, by no

It may likewise be acknowledged, that no arguments which we are in possession of, exclude the ministry of subordinate agents. If such there be, they act under a presiding, a controlling will; because they act according to certain general restrictions, by certain common rules, and, as it should seem, upon a general plan: but still such agents, and different ranks and classes and degrees of them, may be employed.[65]

means impair his argument as to Unity when rightly considered. These will be fully discussed in the Appendix, and they throw material light upon other branches of the subject.

[65] Addison, a person of practical understanding, calm temperament, and widely removed from all enthusiasm (Spectator, No. 110), states very plainly his belief in spirits, not in the religious and philosophical sense of subordinate agents, adopted by Dr. Paley, but in the popular sense of ghosts. He rests his opinion, as Dr. Johnson did his strong inclination towards the same belief, upon the cogency of testimony. Respecting witchcraft, he elsewhere (No. 117) expresses the inclination of his opinion in favour of it generally and abstractedly; but refusing all credit to particular instances. The feeling which dictates such a disposition to believe in a spiritual world is natural, as well as amiable; but it may be questioned if religion does not lose as much as it can gain by indulging in it.

CHAPTER XXVI.

OF THE GOODNESS OF THE DEITY.

The proof of the *divine goodness* rests upon two propositions: each, as we contend, capable of being made out by observations drawn from the appearances of nature.

The first is, "that in a vast plurality of instances in which contrivance is perceived, the design of the contrivance is *beneficial*."

The second, "that the Deity has superadded *pleasure* to animal sensations beyond what was necessary for any other purpose, or when the purpose, so far as it was necessary, might have been effected by the operation of pain."

First, "in a vast plurality of instances in which contrivance is perceived, the design of the contrivance is *beneficial*."

No productions of nature display contrivance so manifestly as the parts of animals; and the parts of animals have all of them, I believe, a real, and, with very few exceptions, all of them a known and intelligible subserviency to the use of the animal. Now, when the multitude of animals is considered, the number of parts in each, their figure and fitness, the faculties depending upon them, the variety of species, the complexity of structure, the success, in so many cases, and felicity of the result, we can never reflect, without the profoundest adoration, upon the character of that Being from whom all these things have proceeded: we cannot help acknowledging what an exertion of benevolence creation was; of a benevolence how minute in its care, how vast in its comprehension!

When we appeal to the parts and faculties of animals, and to the limbs and senses of animals in particular, we

state, I conceive, the proper medium of proof for the conclusion which we wish to establish. I will not say that the insensible parts of nature are made solely for the sensitive parts; but this I say, that when we consider the benevolence of the Deity, we can only consider it in relation to sensitive being. Without this reference, or referred to anything else, the attribute has no object, the term has no meaning. Dead matter is nothing. The parts, therefore, especially the limbs and senses, of animals, although they constitute in mass and quantity a small portion of the material creation, yet, since they alone are instruments of perception, they compose what may be called the whole of visible nature, estimated with a view to the disposition of its Author. Consequently, it is in *these* that we are to seek his character. It is by these that we are to prove that the world was made with a benevolent design.

Nor is the design abortive. It is a happy world after all. The air, the earth, the water, teem with delighted existence. In a spring noon or a summer evening, on whichever side I turn my eyes, myriads of happy beings crowd upon my view. "The insect youth are on the wing." Swarms of new-born *flies* are trying their pinions in the air. Their sportive motions, their wanton mazes, their gratuitous activity, their continual change of place without use or purpose, testify their joy and the exultation which they feel in their lately discovered faculties. A *bee* amongst the flowers in spring is one of the most cheerful objects that can be looked upon. Its life appears to be all enjoyment, so busy and so pleased; yet it is only a specimen of insect life, with which, by reason of the animal being half domesticated, we happen to be better acquainted than we are with that of others. The *whole-winged* insect tribe, it is probable, are equally intent upon their proper employments, and, under every variety of constitution, gratified, and perhaps equally gratified, by the offices which the Author of their nature has assigned to them. But the atmosphere is not the only scene of enjoyment for the insect race. Plants are covered with aphides, greedily sucking their juices, and

constantly, as it should seem, in the act of sucking. It cannot be doubted but that this is a state of gratification. What else should fix them so close to the operation, and so long? Other species are *running about*, with an alacrity in their motions which carries with it every mark of pleasure. Large patches of ground are sometimes half covered with these brisk and sprightly natures. If we look to what the *waters* produce, shoals of the fry of fish frequent the margins of rivers, of lakes, and of the sea itself. These are so happy, that they know not what to do with themselves. Their attitudes, their vivacity, their leaps out of the water, their frolics in it (which I have noticed a thousand times with equal attention and amusement), all conduce to show their excess of spirits, and are simply the effects of that excess. Walking by the sea-side, in a calm evening, upon a sandy shore, and with an ebbing tide, I have frequently remarked the appearance of a dark cloud, or rather very thick mist, hanging over the edge of the water, to the height, perhaps, of half a yard, and of the breadth of two or three yards, stretching along the coast as far as the eye could reach, and always retiring with the water. When this cloud came to be examined, it proved to be nothing else than so much space filled with young *shrimps*, in the act of bounding into the air from the shallow margin of the water, or from the wet sand. If any motion of a mute animal could express delight, it was this: if they had meant to make signs of their happiness, they could not have done it more intelligibly. Suppose, then, what I have no doubt of, each individual of this number to be in a state of positive enjoyment; what a sum, collectively, of gratification and pleasure have we here before our view![66]

The *young* of all animals appear to me to receive

[66] To these considerations it must be added, that the lives of such animals may be only apparently short. If time is but the succession of ideas, then, as Soame Jenyns has observed, the insect that flutters for a single summer's day may in reality live as long as the tortoise that breathes for a century.

pleasure simply from the exercise of their limbs and bodily faculties, without reference to any end to be attained, or any use to be answered by the exertion. A child, without knowing anything of the use of language, is in a high degree delighted with being able to speak. Its incessant repetition of a few articulate sounds, or, perhaps, of the single word which it has learnt to pronounce, proves this point clearly. Nor is it less pleased with its first successful endeavours to walk, or rather to run (which precedes walking), although entirely ignorant of the importance of the attainment to its future life, and even without applying it to any present purpose. A child is delighted with speaking, without having anything to say, and with walking, without knowing where to go. And, prior to both these, I am disposed to believe that the waking hours of infancy are agreeably taken up with the exercise of vision, or perhaps, more properly speaking, with learning to see.

But it is not for youth alone that the great Parent of creation hath provided. Happiness is found with the purring cat, no less than with the playful kitten; in the arm-chair of dozing age, as well as in either the sprightliness of the dance, or the animation of the chase. To novelty, to acuteness of sensation, to hope, to ardour of pursuit, succeeds, what is, in no inconsiderable degree, an equivalent for them all, "perception of ease." Herein is the exact difference between the young and the old. The young are not happy but when enjoying pleasure; the old are happy when free from pain. And this constitution suits with the degrees of animal power which they respectively possess. The vigour of youth was to be stimulated to action by impatience of rest; whilst to the imbecility of age, quietness and repose become positive gratifications. In one important respect the advantage is with the old. A state of ease is, generally speaking, more attainable than a state of pleasure. A constitution, therefore, which can enjoy ease, is preferable to that which can taste only pleasure. This same perception of ease oftentimes renders old age a condition of great comfort, especially when riding at its anchor

after a busy or tempestuous life. It is well described by Rousseau, to be the interval of repose and enjoyment between the hurry and the end of life. How far the same cause extends to other animal natures cannot be judged of with certainty. The appearance of satisfaction with which most animals, as their activity subsides, seek and enjoy rest, affords reason to believe that this source of gratification is appointed to advanced life, under all or most of its various forms. In the species with which we are best acquainted, namely, our own, I am far, even as an observer of human life, from thinking that youth is its happiest season, much less the only happy one: as a Christian, I am willing to believe that there is a great deal of truth in the following representation given by a very pious writer, as well as excellent man :*—" To the intelligent and virtuous, old age presents a scene of tranquil enjoyments, of obedient appetite, of well-regulated affections, of maturity in knowledge, and of calm preparation for immortality. In this serene and dignified state, placed as it were on the confines of two worlds, the mind of a good man reviews what is past with the complacency of an approving conscience, and looks forward, with humble confidence in the mercy of God, and with devout aspirations, towards his eternal and ever-increasing favour."

What is seen in different stages of the same life, is still more exemplified in the lives of different animals. Animal enjoyments are infinitely *diversified*. The modes of life, to which the organisation of different animals respectively determines them, are not only of various, but of opposite kinds. Yet each is happy in its own. For instance: animals of prey live much alone; animals of a milder constitution in society. Yet the herring, which lives in shoals, and the sheep, which lives in flocks, are not more happy in a crowd, or more contented amongst their companions, than is the pike or the lion, with the deep solitudes of the pool or the forest.

But it will be said that the instances which we have

* Father's Instructions, by Dr. Percival, of Manchester, p. 317.

here brought forward, whether of vivacity or repose, or of apparent enjoyment derived from either, are picked and favourable instances. We answer, first, that they are instances, nevertheless, which comprise large provinces of sensitive existence; that every case which we have described is the case of millions. At this moment, in every given moment of time, how many myriads of animals are eating their food, gratifying their appetites, ruminating in their holes, accomplishing their wishes, pursuing their pleasures, taking their pastimes! In each individual, how many things must go right for it to be at ease; yet how large a proportion out of every species is so in every assignable instant! Secondly, we contend, in the terms of our original proposition, that throughout the whole of life, as it is diffused in nature, and as far as we are acquainted with it, looking to the average of sensations, the plurality and the preponderancy is in favour of happiness by a vast excess. In our own species, in which, perhaps, the assertion may be more questionable than any other, the prepollency of good over evil, of health, for example, and ease, over pain and distress, is evinced by the very notice which calamities excite. What inquiries does the sickness of our friends produce! what conversation their misfortunes! This shows that the common course of things is in favour of happiness; that happiness is the rule, misery the exception. Were the order reversed, our attention would be called to examples of health and competency, instead of disease and want.

One great cause of our insensibility to the goodness of the Creator, is the very *extensiveness* of his bounty. We prize but little what we share only in common with the rest, or with the generality of our species. When we hear of blessings, we think forthwith of successes, of prosperous fortunes, of honours, riches, preferments, *i. e.* of those advantages and superiorities over others, which we happen either to possess, or to be in pursuit of, or to covet. The common benefits of our nature entirely escape us. Yet these are the great things. These constitute what most properly ought to be accounted bless-

ings of Providence; what alone, if we might so speak, are worthy of its care. Nightly rest and daily bread, the ordinary use of our limbs, and senses, and understandings, are gifts which admit of no comparison with any other. Yet, because almost every man we meet with possesses these, we leave them out of our enumeration. They raise no sentiment; they move no gratitude. Now, herein is our judgment perverted by our selfishness. A blessing ought in truth to be the *more* satisfactory—the bounty at least of the donor is rendered more conspicuous —by its very diffusion, its commonness, its cheapness; by its falling to the lot and forming the happiness of the great bulk and body of our species, as well as of ourselves. Nay, even when we do not possess it, it ought to be matter of thankfulness that others do. But we have a different way of thinking. We court distinction. That is not the worst; we *see* nothing but what has distinction to recommend it. This necessarily contracts our views of the Creator's beneficence within a narrow compass, and most unjustly. It is in those things which are so common as to be no distinction, that the amplitude of the Divine benignity is perceived.

But pain, no doubt, and privations exist in numerous instances, and to a great degree, which collectively would be very great, if they were compared with any other thing than with the mass of animal fruition. For the application, therefore, of our proposition to that *mixed* state of things which these exceptions induce, two rules are necessary, and both, I think, just and fair rules. One is, that we regard those effects alone which are accompanied with proofs of intention; the other, that when we cannot resolve all appearances into benevolence of design, we make the few give place to the many; the little to the great; that we take our judgment from a large and decided preponderancy, if there be one.[67]

[67] This passage, with others which afterwards occur in this work, as well as the part here quoted from the author's Moral Philosophy, has been, it should seem, somewhat misunderstood by several excellent authors, who have treated him as if he were denying the existence of evil; and have

I crave leave to transcribe into this place what I have said upon this subject in my Moral Philosophy :—

" When God created the human species, either he wished their happiness, or he wished their misery, or he was indifferent and unconcerned about either.

" If he had wished our misery, he might have made sure of his purpose, by forming our senses to be so many sores and pains to us, as they are now instruments of gratification and enjoyment : or by placing us amidst objects so ill suited to our perceptions, as to have continually offended us, instead of ministering to our refreshment and delight. He might have made, for example, every thing we tasted, bitter ; every thing we saw, loathsome ; every thing we touched, a sting ; every smell, a stench ; and every sound, a discord.

" If he had been indifferent about our happiness or misery, we must impute to our good fortune (as all design by this supposition is excluded) both the capacity of our senses to receive pleasure, and the supply of external objects fitted to produce it.

" But either of these, and still more both of them, being too much to be attributed to accident, nothing remains but the first supposition, that God, when he created the human species, wished their happiness ; and

referred, though without any sceptical view, to the old dilemma of the Epicureans, stated by Lactantius :—" Aut vult, et non potest ; aut potest et non vult tollere mala." But Dr. Paley's whole discourse upon this subject must be taken as an attempt, and a successful one, to diminish the apparent amount of evil, by showing that many of the things accounted evils are less bad than they seem to be. He explains the deductions which are fairly to be made ; he shows the compensations which exist ; he proves that out of evil good frequently arises. Having done this, evil still remains, but in an amount exceedingly reduced ; and this remaining portion is that concerning which alone the question arises. All that follows of the text must be read with this view ; and it must be admitted that nothing can be more legitimate than the scope of the reasoning employed if regarded in this light. Viewed in any other, it would be liable to the objections which have been urged against it.

made for them the provision which he has made, with that view and for that purpose.

"The same argument may be proposed in different terms; *thus:* Contrivance proves design; and the predominant tendency of the contrivance indicates the disposition of the designer. The world abounds with contrivances; and all the contrivances which we are acquainted with are directed to beneficial purposes. Evil, no doubt, exists; but is never, that we can perceive, the *object* of contrivance. Teeth are contrived to eat, not to ache; their aching now and then is incidental to the contrivance, perhaps inseparable from it: or even, if you will, let it be called a defect in the contrivance; but it is not the object of it. This is a distinction which well deserves to be attended to. In describing implements of husbandry, you would hardly say of the sickle, that it is made to cut the reaper's hand: though from the construction of the instrument, and the manner of using it, this mischief often follows. But if you had occasion to describe instruments of torture, or execution, —this engine, you would say, is to extend the sinews; this to dislocate the joints; this to break the bones; this to scorch the soles of the feet. Here, pain and misery are the very objects of the contrivance. Now, nothing of this sort is to be found in the works of nature. We never discover a train of contrivance to bring about an evil purpose. No anatomist ever discovered a system of organisation calculated to produce pain and disease; or, in explaining the parts of the human body, ever said, this is to irritate; this to inflame; this duct is to convey the gravel to the kidneys; this gland to secrete the humour which forms the gout: if by chance he come at a part of which he knows not the use, the most he can say is, that it is useless; no one ever suspects that it is put there to incommode, to annoy, or to torment."

The two cases which appear to me to have the most difficulty in them, as forming the most of the appearance of exception to the representation here given, are those of *venomous* animals, and of animals *preying* upon one another. These properties of animals, wherever they

are found, must, I think, be referred to design ; because there is in all cases of the first, and in most cases of the second, an express and distinct organisation provided for the producing of them. Under the first head, the fangs of vipers, the stings of wasps and scorpions, are as clearly intended for their purpose, as any animal structure is for any purpose the most incontestably beneficial. And the same thing must, under the second head, be acknowledged of the talons and beaks of birds, of the tusks, teeth, and claws of beasts of prey ; of the shark's mouth, of the spider's web, and of numberless weapons of offence belonging to different tribes of voracious insects. We cannot, therefore, avoid the difficulty by saying, that the effect was not intended. The only question open to us is, whether it be ultimately evil. From the confessed and felt imperfection of our knowledge, we ought to presume, that there may be consequences of this œconomy which are hidden from us: from the benevolence which pervades the general designs of nature, we ought also to presume, that these consequences, if they could enter into our calculation, would turn the balance on the favourable side. Both these I contend to be reasonable presumptions. Not reasonable presumptions, if these two cases were the only cases which nature presented to our observation ; but reasonable presumptions under the reflection, that the cases in question are combined with a multitude of intentions, all proceeding from the same author, and all, except these, directed to ends of undisputed utility. Of the vindications, however, of this œconomy, which we are able to assign, such as most extenuate the difficulty are the following.

With respect to *venomous* bites and stings, it may be observed,—

1. That, the animal itself being regarded, the faculty complained of is *good;* being conducive, in all cases, to the defence of the animal ; in some cases, to the subduing of its prey ; and in some, probably, to the killing of it, when caught, by a mortal wound, inflicted in the passage to the stomach, which may be no less merciful to the

victim, than salutary to the devourer. In the viper, for instance, the poisonous fang may do that which, in other animals of prey, is done by the crush of the teeth. Frogs and mice might be swallowed alive without it.

2. But it will be said, that this provision, when it comes to the case of bites, deadly even to human bodies, and to those of large quadrupeds, is greatly *overdone;* that it might have fulfilled its use, and yet have been much less deleterious than it is. Now I believe the case of bites which produce death in large animals (of stings I think there are none) to be very few. The experiments of the Abbé Fontana, which were numerous, go strongly to the proof of this point. He found that it required the action of five exasperated vipers to kill a dog of a moderate size; but that to the killing of a mouse, or a frog, a single bite was sufficient; which agrees with the use which we assign to the faculty. The Abbé seemed to be of opinion, that the bite even of the rattlesnake would not usually be mortal; allowing, however, that in certain particularly unfortunate cases, as when the puncture had touched some very tender part, pricked a principal nerve, for instance, or, as it is said, some more considerable lymphatic vessel, death might speedily ensue.

3. It has been, I think, very justly remarked, concerning serpents, that, whilst only a few species possess the venomous property, that property guards the whole tribe. The most innocuous snake is avoided with as much care as a viper. Now the terror with which large animals regard this class of reptiles is its protection; and this terror is founded on the formidable revenge which a few of the number, compared with the whole, are capable of taking. The species of serpents, described by Linnæus, amount to two hundred and eighteen, of which thirty-two only are poisonous.

4. It seems to me, that animal constitutions are provided, not only for each element, but for each state of the elements, *i. e.* for every climate, and for every temperature; and that part of the mischief complained of arises from animals (the human animal most especially)

occupying situations upon the earth which do not belong to them, nor were ever intended for their habitation. The folly and wickedness of mankind, and necessities proceeding from these causes, have driven multitudes of the species to seek a refuge amongst burning sands, whilst countries, blessed with hospitable skies, and with the most fertile soils, remain almost without a human tenant. We invade the territories of wild beasts and venomous reptiles, and then complain that we are infested by their bites and stings. Some accounts of Africa place this observation in a strong point of view. "The deserts," says Adanson, "are entirely barren, except where they are found to produce serpents; and in such quantities, that some extensive plains are almost entirely covered with them." These are the natures appropriated to the situation. Let them enjoy their existence; let them have their country. Surface enough will be left to man, though his numbers were increased a hundred-fold, and left to him, where he might live exempt from these annoyances.

The SECOND CASE, *viz.* that of animals *devouring* one another, furnishes a consideration of much larger extent. To judge whether, as a general provision, this can be deemed an *evil*, even so far as we understand its consequences, which, probably, is a partial understanding, the following reflections are fit to be attended to.[68]

[68] The subject of apparently conflicting contrivances, including conflicting instincts, as well as apparently imperfect contrivances and instincts, will be considered at large in the Appendix. The progress of science is constantly diminishing the number of such instances, as far as our ignorance of design goes. That some conflict will continue,—in other words, that evil to a certain amount will, after all deductions, be found to exist, cannot be doubted. But that an immense preponderance of good exists in every department of nature, both of matter and of mind, is so clear, that, arguing as we do on every other subject, we have a right to impute the perception of any evil at all to our own ignorance, and to conclude that, if we knew the whole system, and could extend our comprehension to the entire plan of creation, we should no longer believe there was evil at all.

1. Immortality upon this earth is out of the question. Without death there could be no generation, no sexes, no parental relation, *i. e.* as things are constituted, no animal happiness. The particular duration of life, assigned to different animals, can form no part of the objection; because, whatever that duration be, whilst it remains finite and limited, it may always be asked, why it is no longer. The natural age of different animals varies, from a single day to a century of years. No account can be given of this; nor could any be given, whatever other proportion of life had obtained amongst them.

The term then of life in different animals being the same as it is, the question is, what mode of taking it away is the best even for the animal itself.

Now, according to the established order of nature (which we must suppose to prevail, or we cannot reason at all upon the subject), the three methods by which life is usually put an end to are acute diseases, decay, and violence. The simple and natural life of *brutes* is not often visited by acute distempers; nor could it be deemed an improvement of their lot if they were. Let it be considered, therefore, in what a condition of suffering and misery a brute animal is placed which is left to perish by *decay*. In human sickness or infirmity, there is the assistance of man's rational fellow-creatures, if not to alleviate his pains, at least to minister to his necessities, and to supply the place of his own activity. A brute, in his wild and natural state, does every thing for himself. When his strength, therefore, or his speed, or his limbs, or his senses fail him, he is delivered over, either to absolute famine or to the protracted wretchedness of a life slowly wasted by the scarcity of food. Is

Of the different hypotheses to which we may have recourse for explaining what we are unable legitimately to solve, the Probationary State is one, and is the one which appears to tally best with the facts. It is hardly necessary to add that we are now, as throughout these notes, after the example of the author, confining ourselves altogether to the intimations received from natural reason and observation, unaided by the light of revelation.

it then to see the world filled with drooping, superannuated, half-starved, helpless, and unhelped animals that you would alter the present system of pursuit and prey ?

2. Which system is also to them the spring of motion and activity on both sides. The pursuit of its prey forms the employment, and appears to constitute the pleasure, of a considerable part of the animal creation. The using of the means of defence, or flight, or precaution, forms also the business of another part. And even of this latter tribe, we have no reason to suppose that their happiness is much molested by their fears. Their danger exists continually; and in some cases they seem to be so far sensible of it, as to provide, in the best manner they can, against it; but it is only when the attack is actually made upon them, that they appear to suffer from it. To contemplate the insecurity of their condition with anxiety and dread, requires a degree of reflection, which (happily for themselves) they do not possess. A *hare*, notwithstanding the number of its dangers and its enemies, is as playful an animal as any other.

3. But, to do justice to the question, the system of animal *destruction* ought always to be considered in strict connexion with another property of animal nature, viz. *superfecundity*. They are countervailing qualities. One subsists by the correction of the other. In treating, therefore, of the subject under this view (which is, I believe, the true one), our business will be, first, to point out the advantages which are gained by the powers in nature of a superabundant multiplication; and then to show, that these advantages are so many reasons for appointing that system of national hostilities, which we are endeavouring to account for.

In almost all cases, nature produces her supplies with profusion. A single cod-fish spawns, in one season, a greater number of eggs than all the inhabitants of England amount to. A thousand other instances of prolific generation might be stated, which, though not equal to this, would carry on the increase of the species with a rapidity which outruns calculation, and to an immeasurable extent. The advantages of such a constitution are

two: first, that it tends to keep the world always full; whilst, secondly, it allows the proportion between the several species of animals to be differently modified, as different purposes require, or as different situations may afford for them room and food. Where this vast fecundity meets with a vacancy fitted to receive the species, there it operates with its whole effect; there it pours in its numbers and replenishes the waste. We complain of what we call the exorbitant multiplication of some troublesome insects; not reflecting, that large portions of nature might be left void without it. If the accounts of travellers may be depended upon, immense tracts of forests in North America would be nearly lost to sensitive existence, if it were not for *gnats*. "In the thinly inhabited regions of America, in which the waters stagnate and the climate is warm, the whole air is filled with crowds of these insects." Thus it is, that where we looked for solitude and death-like silence, we meet with animation, activity, enjoyment; with a busy, a happy, and a peopled world. Again: hosts of *mice* are reckoned amongst the plagues of the north-east part of Europe; whereas vast plains in Siberia, as we learn from good authority, would be lifeless without them. The Caspian deserts are converted by their presence into crowds of warrens. Between the Volga and the Yaik, and in the country of Hyrcania, the ground, says Pallas, is in many places *covered* with little hills, raised by the earth cast out in forming the burrows. Do we so envy these blissful abodes, as to pronounce the fecundity by which they are supplied with inhabitants to be an evil; a subject of complaint, and not of praise? Further; by virtue of this same superfecundity, what we term destruction becomes almost instantly the parent of life. What we call blights are oftentimes legions of animated beings, claiming their portion in the bounty of nature. What corrupts the produce of the earth to us, prepares it for them. And it is by means of their rapid multiplication, that they take possession of their pasture; a slow propagation would not meet the opportunity.

But in conjunction with the occasional use of this

fruitfulness, we observe, also, that it allows the proportion between the several species of animals to be differently modified, as different purposes of utility may require. When the forests of America come to be cleared, and the swamps drained, our gnats will give place to other inhabitants. If the population of Europe should spread to the north and the east, the mice will retire before the husbandman and the shepherd, and yield their station to herds and flocks. In what concerns the human species, it may be a part of the scheme of Providence, that the earth should be inhabited by a shifting, or perhaps a circulating population. In this œconomy, it is possible that there may be the following advantages: When old countries are become exceedingly corrupt, simpler modes of life, purer morals, and better institutions, may rise up in new ones, whilst fresh soils reward the cultivator with more plentiful returns. Thus the different portions of the globe come into use in succession as the residence of man; and, in his absence, entertain other guests, which, by their sudden multiplication, fill the chasm. In domesticated animals, we find the effect of their fecundity to be, that we can always command *numbers;* we can always have as many of any particular species as we please, or as we can support. Nor do we complain of its excess; it being much more easy to regulate abundance, than to supply scarcity.

But then this *superfecundity*, though of great occasional use and importance, exceeds the ordinary capacity of nature to receive or support its progeny. All superabundance supposes destruction, or must destroy itself. Perhaps there is no species of terrestrial animals whatever, which would not overrun the earth, if it were permitted to multiply in perfect safety; or of fish, which would not fill the ocean: at least, if any single species were left to their natural increase without disturbance or restraint, the food of other species would be exhausted by their maintenance. It is necessary, therefore, that the effects of such prolific faculties be curtailed. In conjunction with other checks and limits, all subservient to the same purpose, are the *thinnings* which take place among ani-

mals, by their action upon one another. In some instances we ourselves experience, very directly, the use of these hostilities. One species of insects rids us of another species, or reduces their ranks. A third species, perhaps, keeps the second within bounds; and birds or lizards are a fence against the inordinate increase by which even these last might infest us. In other, more numerous, and possibly more important instances, this disposition of things, although less necessary or useful to us, and of course less observed by us, may be necessary and useful to certain other species; or even for the preventing of the loss of certain species from the universe: a misfortune which seems to be studiously guarded against. Though there may be the appearance of failure in some of the details of Nature's works, in her great purposes there never are. Her species never fail. The provision which was originally made for continuing the replenishment of the world has proved itself to be effectual through a long succession of ages.

What further shows, that the system of destruction amongst animals holds an express relation to the system of fecundity,—that they are parts indeed of one compensatory scheme,—is, that in each species the fecundity bears a proportion to the smallness of the animal, to the weakness, to the shortness of its natural term of life, and to the dangers and enemies by which it is surrounded. An elephant produces but one calf; a butterfly lays six hundred eggs. Birds of prey seldom produce more than two eggs: the sparrow tribe, and the duck tribe, frequently sit upon a dozen. In the rivers, we meet with a thousand minnows for one pike; in the sea, a million of herrings for a single shark. Compensation obtains throughout. Defencelessness and devastation are repaired by fecundity.

We have dwelt the longer on these considerations, because the subject to which they apply, namely, that of animals *devouring* one another, forms the chief, if not the only instance, in the works of the Deity, of an œconomy, stamped by marks of design, in which the character of utility can be called in question. The case of

venomous animals is of much inferior consequence to the case of prey, and, in some degree, is also included under it. To both cases it is probable that many more reasons belong, than those of which we are in possession.

Our FIRST PROPOSITION, and that which we have hitherto been defending, was, "that, in a vast plurality of instances, in which *contrivance* is perceived, the design of the contrivance is beneficial."

Our SECOND PROPOSITION is, "that the Deity has added *pleasure* to animal sensations, beyond what was necessary for any other purpose, or when the purpose, so far as it was necessary, might have been effected by the operation of pain." [69]

This proposition may be thus explained: The capacities, which, according to the established course of nature, are *necessary* to the support or preservation of an animal, however manifestly they may be the result of

[69] This is a most important consideration, and one which cannot be dwelt upon too constantly; and which assuredly will, by the contemplative and well-regulated mind, never be dwelt upon without experiencing the most pleasing and salutary influence. It will be further illustrated in the Appendix; but in this place it may be right to add that the induction of facts plainly shows the system of the universe to be governed upon the principle of inducement rather than denouncement,—of reward more than of punishment; and not only are sentient beings guided by the more kindly process where the harsher would have sufficed, but there is more inducement employed, more pleasure superadded, than is even necessary to work the effect intended. It is as if a human lawgiver were to prefer rewarding his subjects for obedience, rather than punishing them for contumacy; and were then to add some bounty beyond what had been found quite sufficient to ensure their compliance. It must be constantly borne in mind that there is not one single act performed by any animal, from man to the lowest insect in the scale, in fulfilling the apparent ends of its creation, the performance of which might not have been secured as effectually by the pressure or by the apprehension of pain, as it now is, in so vast a number of instances, solicited by the enjoyment or the hope of some gratification.

an organisation contrived for the purpose, can only be deemed an act or a part of the same will as that which decreed the existence of the animal itself; because, whether the creation proceeded from a benevolent or a malevolent being, these capacities must have been given, if the animal existed at all. Animal properties, therefore, which fall under this description, do not strictly prove the goodness of God; they may prove the existence of the Deity; they may prove a high degree of power and intelligence; but they do not prove his goodness; forasmuch as they must have been found in any creation which was capable of continuance, although it is possible to suppose, that such a creation might have been produced by a being whose views rested upon misery.

But there is a class of properties, which may be said to be superadded from an intention expressly directed to happiness; an intention to give a happy existence distinct from the general intention of providing the means of existence; and that is, of capacities for pleasure, in cases wherein, so far as the conservation of the individual or of the species is concerned, they were not wanted, or wherein the purpose might have been secured by the operation of pain. The provision which is made of a variety of objects, not necessary to life, and ministering only to our pleasures; and the properties given to the necessaries of life themselves, by which they contribute to pleasure as well as preservation; show a further design than that of giving existence.*

A single instance will make all this clear. Assuming the necessity of food for the support of animal life, it is requisite that the animal be provided with organs fitted for the procuring, receiving, and digesting of its food. It may also be necessary, that the animal be impelled by its sensations to exert its organs. But the pain of

* See this topic considered in Dr. Balguy's Treatise upon the Divine Benevolence. This excellent author first, I think, proposed it, and nearly in the terms in which it is here stated. Some other observations also under this head are taken from that treatise.—*Note of the Author.*

hunger would do all this. Why add pleasure to the act of eating; sweetness and relish to food? why a new and appropriate sense for the perception of the pleasure? Why should the juice of a peach, applied to the palate, affect the part so differently from what it does when rubbed upon the palm of the hand? This is a constitution which, so far as appears to me, can be resolved into nothing but the pure benevolence of the Creator. Eating is necessary; but the pleasure attending it is not necessary: and that this pleasure depends, not only upon our being in possession of the sense of taste, which is different from every other, but upon a particular state of the organ in which it resides, a felicitous adaptation of the organ to the object, will be confessed by any one, who may happen to have experienced that vitiation of taste which frequently occurs in fevers, when every taste is irregular, and every one bad.

In mentioning the gratifications of the palate, it may be said that we have made choice of a trifling example.[70]

[70] Neither this nor any other thing which our nature, physical or moral, is formed to relish, can be deemed trifling; and it is well observed afterwards that the very capacity of being pleased with what, by comparison with other things, are termed trivial matters, is itself a source of enjoyment provided for us by the divine beneficence. All men have within themselves the power of being amused or occupied, and interested—that is, pleased, gratified—with things which, until they make the attempt, they are disposed to regard as wholly incapable of affording any satisfaction. This is a most important source of enjoyment, and one more independent of external circumstances than they could believe who have never made the experiment. "Le goût (says Marmontel, *Mém.* I. 431) s'accommode aux objets dont il peut jouir; et cette sage maxime,

Quand on n'a pas ce que l'on aime,
Il faut aimer ce que l'on a,

est en effet non seulement une leçon de la nature, mais un moyen qu'elle se ménage pour nous procurer des plaisirs." The earlier and by far the most interesting part of his book abounds in illustrations of a kindred truth—the gratification derived from the humblest sources by those who have known

I am not of that opinion. They afford a share of enjoyment to man; but to brutes, I believe that they are of very great importance. A horse at liberty passes a great part of his waking hours in eating. To the ox, the sheep, the deer, and other ruminating animals, the pleasure is doubled. Their whole time almost is divided between browsing upon their pasture and chewing their cud. Whatever the pleasure be, it is spread over a large portion of their existence. If there be animals, such as the lupous fish, which swallow their prey whole, and at once, without any time, as it should seem, for either drawing out, or relishing, the taste in the mouth, is it an improbable conjecture, that the seat of taste with them is in the stomach; or, at least, that a sense of pleasure, whether it be taste or not, accompanies the dissolution of the food in that receptacle, which dissolution in general is carried on very slowly? If this opinion be right, they are more than repaid for the defect of palate. The feast lasts as long as the digestion.

In seeking for argument, we need not stay to insist upon the comparative importance of our example; for the observation holds equally of all, or of three at least, of the other senses. The necessary purposes of hearing might have been answered without harmony; of smell, without fragrance; of vision, without beauty. Now, "if the Deity had been indifferent about our happiness or misery, we must impute to our good fortune (as all design by this supposition is excluded), both the capacity

none other. "Nos galettes de sarrazin, humectées, toutes brûlantes, de ce bon beurre du Mont-d'or, étaient pour nous le plus friand régal. Je ne sais pas quel mets nous eût paru meilleur que nos raves et nos châtaignes; et en hiver, lorsque ces belles raves grillaient le soir à l'entour du foyer, ou que nous entendions bouillonner l'eau du vase où cuisaient ces châtaignes si savoureuses et si douces, le cœur nous palpitait de joie."—(Ib. p. 9.) "Quand j'arrivais chez moi, et que, dans un bon lit ou au coin d'un bon feu, je me sentais tout ranimé, c'était pour moi l'un des moments les plus délicieux de la vie; jouissance que la mollesse ne m'aurait jamais fait connaître."—(Ib. p. 34.)

of our senses to receive pleasure, and the supply of external objects fitted to excite it." I allege these as *two* felicities, for they are different things, yet both necessary: the sense being formed, the objects, which were applied to it, might not have suited it; the objects being fixed, the sense might not have agreed with them. A coincidence is here required, which no accident can account for. There are three possible suppositions upon the subject, and no more. The first; that the sense, by its original constitution, was made to suit the object: The second; that the object, by its original constitution, was made to suit the sense: The third; that the sense is so constituted, as to be able, either universally, or within certain limits, by habit and familiarity, to render every object pleasant. Whichever of these suppositions we adopt, the effect evinces, on the part of the Author of nature, a studious benevolence. If the pleasures which we derive from any of our senses depend upon an original congruity between the sense and the properties perceived by it, we know by experience that the adjustment demanded, with respect to the qualities which were conferred upon the objects that surround us, not only choice and selection, out of a boundless variety of possible qualities with which these objects might have been endued, but a *proportioning also of degree*, because an excess or defect of intensity spoils the perception, as much almost as an error in the kind and nature of the quality. Likewise the degree of dulness or acuteness in the sense itself is no arbitrary thing, but, in order to preserve the congruity here spoken of, requires to be in an exact or near correspondency with the strength of the impression. The dulness of the senses forms the complaint of old age. Persons in fevers, and, I believe, in most maniacal cases, experience great torment from their preternatural acuteness. An increased, no less than an impaired sensibility, induces a state of disease and suffering.

The doctrine of a specific congruity between animal senses and their objects is strongly favoured by what is observed of insects in the election of their food. Some

of these will feed upon one kind of plant or animal, and upon no other: some caterpillars upon the cabbage alone, some upon the black currant alone. The species of caterpillar which eats the vine will starve upon the alder: nor will that which we find upon fennel touch the rose-bush. Some insects confine themselves to two or three kinds of plants or animals. Some again show so strong a preference as to afford reason to believe that, though they may be driven by hunger to others, they are led by the pleasure of taste to a few particular plants alone; and all this, as it should seem, independently of habit or imitation.

But should we accept the third hypothesis, and even carry it so far as to ascribe every thing which concerns the question to habit (as in certain species, the human species most particularly, there is reason to attribute something), we have then before us an animal capacity, not less perhaps to be admired than the native congruities which the other scheme adopts. It cannot be shown to result from any fixed necessity in nature, that what is frequently applied to the senses should of course become agreeable to them. It is, so far as it subsists, a power of accommodation provided in these senses by the Author of their structure, and forms a part of their perfection.

In whichever way we regard the senses, they appear to be specific gifts, ministering, not only to preservation, but to pleasure. But what we usually call the *senses* are probably themselves far from being the only vehicles of enjoyment, or the whole of our constitution which is calculated for the same purpose. We have many internal sensations of the most agreeable kind, hardly referable to any of the five senses. Some physiologists have holden that all secretion is pleasurable; and that the complacency which in health, without any external assignable object to excite it, we derive from life itself, is the effect of our secretions going on well within us. All this may be true; but if true, what reason can be assigned for it, except the will of the Creator? It may reasonably be asked, Why is any thing a pleasure? and I

know no answer which can be returned to the question, but that which refers it to appointment.

We can give no account whatever of our pleasures in the simple and original perception; and, even when physical sensations are assumed, we can seldom account for them in the secondary and complicated shapes in which they take the name of diversions. I never yet met with a sportsman who could tell me in what the sport consisted; who could resolve it into its principle, and state that principle. I have been a great follower of fishing myself, and in its cheerful solitude have passed some of the happiest hours of a sufficiently happy life; but, to this moment, I could never trace out the source of the pleasure which it afforded me.

The "quantum in rebus inane!" whether applied to our amusements or to our graver pursuits (to which, in truth, it sometimes equally belongs), is always an unjust complaint. If trifles engage, and if trifles make us happy, the true reflection suggested by the experiment is upon the tendency of nature to gratification and enjoyment; which is, in other words, the goodness of its Author towards his sensitive creation.

Rational natures also, as such, exhibit qualities which help to confirm the truth of our position. The degree of understanding found in mankind is usually much greater than what is necessary for mere preservation. The pleasure of choosing for themselves, and of prosecuting the object of their choice, should seem to be an original source of enjoyment. The pleasures received from things great, beautiful, or new, from imitation, or from the liberal arts, are, in some measure, not only superadded, but unmixed, gratifications, having no pains to balance them.*

I do not know whether our attachment to *property* be not something more than the mere dictate of reason, or even than the mere effect of association. Property communicates a charm to whatever is the object of it. It is the first of our abstract ideas; it cleaves to us the closest

* Balguy on the Divine Benevolence.

and the longest. It endears to the child its plaything, to the peasant his cottage, to the landholder his estate. It supplies the place of prospect and scenery. Instead of coveting the beauty of distant situations, it teaches every man to find it in his own. It gives boldness and grandeur to plains and fens, tinge and colouring to clays and fallows.

All these considerations come in aid of our *second* proposition. The reader will now bear in mind what our two propositions were. They were, firstly, that in a vast plurality of instances, in which contrivance is perceived, the design of the contrivance is beneficial; secondly, that the Deity has added pleasure to animal sensations beyond what was necessary for any other purpose: or when the purpose, so far as it was necessary, might have been effected by the operation of pain.

Whilst these propositions can be maintained, we are authorised to ascribe to the Deity the character of benevolence; and what is benevolence at all, must in him be *infinite* benevolence, by reason of the infinite, that is to say, the incalculably great, number of objects upon which it is exercised.

Of the ORIGIN OF EVIL no universal solution has been discovered; I mean, no solution which reaches to all cases of complaint. The most comprehensive is that which arises from the consideration of *general rules*.[71]

[71] These observations on General Laws, and those which follow upon the doctrine of Imperfections, have been misunderstood in the same way with the former remarks, referred to in the second note upon this chapter; but it must be allowed that the expressions here used respecting General Laws are somewhat incautious, and more liable to cavil. Nevertheless, the whole scope of the argument which follows plainly shows that our author never thought of solving the difficulty as to evil by resorting to the existence of laws, which are themselves only the modes of acting pursued by the Deity himself. In truth this portion of his argument is, like that on which we formerly commented, only to be considered as stating a deduction to be made from the total amount of evil; in other words, the reasoning is only a re-

We may, I think, without much difficulty, be brought to admit the four following points: first, that important advantages may accrue to the universe from the order of nature proceeding according to general laws: secondly, that general laws, however well set and constituted, often thwart and cross one another: thirdly, that from these thwartings and crossings, frequent particular inconveniences will arise: and, fourthly, that it agrees with our observation to suppose, that some degree of these inconveniences takes place in the works of nature. These points may be allowed; and it may also be asserted, that the general laws with which we are acquainted are directed to beneficial ends. On the other hand, with many of these laws we are not acquainted at all, or we are totally unable to trace them in their branches, and in their operation; the effect of which ignorance is, that they cannot be of importance to us as measures by which to regulate our conduct. The conversation of them may be of importance in other respects, or to other beings, but we are uninformed of their value or use; uninformed consequently, when, and how far, they may or may not be suspended, or their effects turned aside, by a presiding and benevolent will, without incurring greater evils than those which would be avoided. The consideration, therefore, of general laws, although it may concern the question of the origin of evil very nearly (which I think it does), rests in views disproportionate to our faculties, and in a knowledge which we do not possess. It serves rather to account for the obscurity of the subject, than to supply us with distinct answers to our difficulties. However, whilst we assent to the above stated propositions, as principles, whatever uncertainty we may find in the application, we lay a ground for believing, that cases of apparent evil, for which *we* can suggest no particular reason, are governed by reasons, which are more general, which lie deeper in

duction of the apparent quantity to the real. Anything beyond this would really be recurring to the ancient doctrine of the heathens, whose gods were limited in power and controlled by fate.

the order of second causes, and which on that account are removed to a greater distance from us.

The doctrine of *imperfections*, or, as it is called, of evils of imperfection, furnishes an account, founded, like the former, in views of universal nature. The doctrine is briefly this:—It is probable, that creation may be better replenished by sensitive beings of different sorts, than by sensitive beings all of one sort. It is likewise probable, that it may be better replenished by different orders of beings rising one above another in gradation, than by beings possessed of equal degrees of perfection. Now, a gradation of such beings implies a gradation of imperfections. No class can justly complain of the imperfections which belong to its place in the scale, unless it were allowable for it to complain, that a scale of being was appointed in nature; for which appointment there appear to be reasons of wisdom and goodness.

In like manner *finiteness*, or what is resolvable into finiteness, in inanimate subjects, can never be a just subject of complaint; because if it were ever so, it would be always so: we mean, that we can never reasonably demand that things should be larger or more, when the same demand might be made, whatever the quantity or number was.

And to me it seems that the sense of mankind has so far acquiesced in these reasons, as that we seldom complain of evils of this class, when we clearly perceive them to be such. What I have to add, therefore, is, that we ought not to complain of some other evils, which stand upon the same foot of vindication as evils of confessed imperfection. We never complain, that the globe of our earth is too small: nor should we complain, if it were even much smaller. But where is the difference to us, between a less globe, and part of the present being uninhabitable? The inhabitants of an island may be apt enough to murmur at the sterility of some parts of it, against its rocks, or sands, or swamps: but no one thinks himself authorised to murmur, simply because the island is not larger than it is. Yet these are the same griefs.

The above are the two metaphysical answers which have been given to this great question. They are not the worse for being metaphysical, provided they be founded (which I think they are) in right reasoning: but they are of a nature too wide to be brought under our survey, and it is often difficult to apply them in the detail. Our speculations, therefore, are perhaps better employed when they confine themselves within a narrower circle.

The observations which follow are of this more limited, but more determinate, kind.

Of *bodily pain*, the principal observation, no doubt, is that which we have already made, and already dwelt upon, *viz.* "that it is seldom the object of contrivance; that when it is so, the contrivance rests ultimately in good."

To which, however, may be added, that the annexing of pain to the means of destruction is a salutary provision; inasmuch as it teaches vigilance and caution: both gives notice of danger, and excites those endeavours which may be necessary to preservation. The evil consequence, which sometimes arises from the want of that timely intimation of danger which pain gives, is known to the inhabitants of cold countries by the example of frost-bitten limbs. I have conversed with patients who had lost toes and fingers by this cause. They have in general told me, that they were totally unconscious of any local uneasiness at the time. Some I have heard declare, that, whilst they were about their employment, neither their situation, nor the state of the air, was unpleasant. They felt no pain; they suspected no mischief; till, by the application of warmth, they discovered too late the fatal injury which some of their extremities had suffered. I say that this shows the use of pain, and that we stand in need of such a monitor. I believe also that the use extends farther than we suppose, or can now trace; that to disagreeable sensations we, and all animals, owe, or have owed, many habits of action which are salutary, but which are become so familiar as not easily to be referred to their origin.

[72] Pain also itself is not without its *alleviations*. It may be violent and frequent; but it is seldom both violent and long-continued: and its pauses and intermissions become positive pleasures. It has the power of shedding a satisfaction over intervals of ease, which, I believe, few enjoyments exceed. A man resting from a fit of the stone or gout is, for the time, in possession of feelings which undisturbed health cannot impart. They may be dearly bought, but still they are to be set against the price. And, indeed, it depends upon the duration and urgency of the pain, whether they be dearly bought or not. I am far from being sure, that a man is not a gainer by suffering a moderate interruption of bodily ease for a couple of hours out of the four and twenty. Two very common observations favour this opinion: one is, that remissions of pain call forth, from those who experience them, stronger expressions of satisfaction and of gratitude towards both the author and the instruments of their relief, than are excited by advantages of any other kind: the second is, that the spirits of sick men do not sink in proportion to the acuteness of their sufferings; but rather appear to be roused and supported, not by pain, but by the high degree of comfort which they derive from its cessation, or even its subsidency, whenever that occurs; and which they taste with a relish that diffuses some portion of mental complacency over the whole of that mixed state of sensations in which disease has placed them.

In connexion with bodily pain may be considered bodily *disease*, whether painful or not. Few diseases are fatal. I have before me the account of a dispensary

[72] This chapter, we are told by Dr. Fenwick, in his sketch of Dr. Clark's life, "was written when Dr. Paley was suffering under severe attacks of a painful disorder under which he had long laboured, and which afterwards proved fatal." Dr. Fenwick justly remarks upon the additional interest which this circumstance communicates to the author's remarks upon the interruptions of pain.—Meadly's Memoirs of Paley, p. 204.

in the neighbourhood, which states six years' experience as follows :—

Admitted	6,420
Cured	5,476
Dead	234

And this I suppose nearly to agree with what other similar institutions exhibit. Now, in all these cases some disorder must have been felt, or the patients would not have applied for a remedy; yet we see how large a proportion of the maladies which were brought forward have either yielded to proper treatment, or, what is more probable, ceased of their own accord. We owe these frequent recoveries, and, where recovery does not take place, this patience of the human constitution under many of the distempers by which it is visited, to two benefactions of our nature. One is, that she works within certain limits; allows of a certain latitude within which health may be preserved, and within the confines of which it only suffers a graduated diminution. Different quantities of food, different degrees of exercise, different portions of sleep, different states of the atmosphere, are compatible with the possession of health. So likewise it is with the secretions and excretions, with many internal functions of the body, and with the state, probably, of most of its internal organs. They may vary considerably, not only without destroying life, but without occasioning any high degree of inconveniency. The other property of our nature, to which we are still more beholden, is its constant endeavour to restore itself, when disordered, to its regular course. The fluids of the body appear to possess a power of separating and expelling any noxious substance which may have mixed itself with them. This they do, in eruptive fevers, by a kind of despumation, as Sydenham calls it, analogous in some measure to the intestine action by which fermenting liquors work the yest to the surface. The solids, on their part, when their action is obstructed, not only resume that action as soon as the obstruction is re-

moved, but they struggle with the impediment. They take an action as near to the true one, as the difficulty and the disorganisation with which they have to contend will allow of.

Of *mortal* diseases, the great use is to reconcile us to death. The horror of death proves the value of life. But it is in the power of disease to abate, or even extinguish, this horror, which it does in a wonderful manner, and oftentimes by a mild and imperceptible gradation. Every man who has been placed in a situation to observe it, is surprised with the change which has been wrought in himself, when he compares the view which he entertains of death upon a sick-bed, with the heart-sinking dismay with which he should some time ago have met it in health. There is no similitude between the sensations of a man led to execution, and the calm expiring of a patient at the close of his disease. Death to him is only the last of a long train of changes, in his progress through which it is possible that he may experience no shocks or sudden transitions.

Death itself, as a mode of removal and of succession, is so connected with the whole order of our animal world, that almost everything in that world must be changed, to be able to do without it. It may seem likewise impossible to separate the fear of death from the enjoyment of life, or the perception of that fear from rational natures. Brutes are in a great measure delivered from all anxiety on this account by the inferiority of their faculties; or rather they seem to be armed with the apprehension of death just sufficiently to put them upon the means of preservation, and no farther. But would a human being wish to purchase this immunity at the expense of those mental powers which enable him to look forward to the future?

Death implies *separation;* and the loss of those whom we love must necessarily, so far as we can conceive, be accompanied with pain. To the brute creation, nature seems to have stepped in with some secret provision for their relief, under the rupture of their attachments. In their instincts towards their offspring, and of their off-

spring to them, I have often been surprised to observe how ardently they love, and how soon they forget. The pertinacity of human sorrow (upon which time also, at length, lays its softening hand) is probably, therefore, in some manner connected with the qualities of our rational or moral nature. One thing, however, is clear, *viz.* that it is better that we should possess affections, the sources of so many virtues and so many joys, although they be exposed to the incidents of life, as well as the interruptions of mortality, than, by the want of them, be reduced to a state of selfishness, apathy, and quietism.[73]

Of other external evils (still confining ourselves to what are called physical or natural evils), a considerable part come within the scope of the following observation:—The great principle of human satisfaction is *engagement*. It is a most just distinction, which the late Mr. Tucker has dwelt upon so largely in his works, between pleasures in which we are passive, and pleasures in which we are active. And I believe every attentive observer of human life will assent to his position, that, however grateful the sensations may occasionally be in which we are passive, it is not these, but the latter class of our pleasures which constitute satisfaction, which supply that regular stream of moderate and miscellaneous enjoyments in which happiness, as distinguished from voluptuousness, consists. Now for rational occupation, which is, in other words, for the very material of contented existence, there would be no place left, if either the things with which we had to do were absolutely impracticable to our endeavours, or if they were too obedient to our uses. A world furnished with advantages on one side, and beset with difficulties, wants, and inconveniences on the other, is the proper abode of free, rational, and active natures, being the fittest to stimulate and exercise their faculties. The very *refractoriness* of the objects they have to deal with contributes to this purpose. A world in which nothing depended upon ourselves, however it might have suited an imaginary race of

[73] The remarks made in note 71 are applicable to this part of the text also.

beings, would not have suited mankind. Their skill, prudence, industry,—their various arts and their best attainments, from the application of which they draw, if not their highest, their most permanent gratifications, would be insignificant, if things could be either moulded by our volitions, or, of their own accord, conformed themselves to our views and wishes. Now it is in this refractoriness that we discern the seed and principle of *physical* evil, as far as it arises from that which is external to us.

Civil evils,[74] or the evils of civil life, are much more easily disposed of than physical evils, because they are in truth of much less magnitude, and also because they result, by a kind of necessity, not only from the constitution of our nature, but from a part of that constitution which no one would wish to see altered. The case is this: Mankind will in every country *breed up* to a certain point of distress. That point may be different in different countries or ages, according to the established usages of life in each. It will also shift upon the scale, so as to admit of a greater or less number of inhabitants, according as the quantity of provision, which is either produced in the country or supplied to it from other countries, may happen to vary. But there must always be such a point, and the species will always breed up to it. The order of generation proceeds by something like a geometrical progression. The increase of provision, under circumstances even the most advantageous, can only assume the form of an arithmetic series. Whence it follows that the population will always overtake the provision, will pass beyond the line of plenty, and will

[74] In all arguments respecting civil and political evils it is important to keep the distinction steadily in view between contentment under necessary sufferings, and quietism under such as may be avoided by improvements in our institutions. Contentment, indeed, under even the latter, is a virtue as well as a solace during the period required for their safe and legitimate amendment; but this is no exception to the rule which we have glanced at, for the sufferings must be considered necessary until their removal can be safely effected.

continue to increase till checked by the difficulty of procuring subsistence.* Such difficulty, therefore, along with its attendant circumstances, *must* be found in every old country; and these circumstances constitute what we call poverty, which necessarily imposes labour, servitude, restraint.

It seems impossible to people a country with inhabitants who shall be all easy in circumstances. For suppose the thing to be done, there would be such marrying and giving in marriage amongst them, as would in a few years change the face of affairs entirely, *i. e.* as would increase the consumption of those articles which supplied the natural or habitual wants of the country to such a degree of scarcity, as must leave the greatest part of the inhabitants unable to procure them without toilsome endeavours, or out of the different kinds of these articles to procure any kind except that which was most easily produced. And this in fact describes the condition of the mass of the community in all countries, a condition unavoidably, as it should seem, resulting from the provision which is made in the human, in common with all animal constitutions, for the perpetuity and multiplication of the species.

It need not, however, dishearten any endeavours for the public service, to know that population naturally treads upon the heels of improvement. If the condition of a people be meliorated, the consequence will be either that the *mean* happiness will be increased, or a greater number partake of it; or, which is most likely to happen, that both effects will take place together. There may be limits fixed by nature to both, but they are limits not yet attained nor even approached in any country of the world.

And when we speak of limits at all, we have respect only to provisions for animal wants. There are sources, and means, and auxiliaries, and augmentations of human happiness, communicable without restriction of numbers, as capable of being possessed by a thousand persons as

* See a statement of this subject in a late treatise upon population.—*Note of the Author.*

by one. Such are those which flow from a mild, contrasted with a tyrannic government, whether civil or domestic; those which spring from religion; those which grow out of a sense of security; those which depend upon habits of virtue, sobriety, moderation, order; those, lastly, which are found in the possession of well-directed tastes and desires, compared with the dominion of tormenting, pernicious, contradictory, unsatisfied, and unsatisfiable passions.

The *distinctions* of civil life are apt enough to be regarded as evils by those who sit under them; but, in my opinion, with very little reason.

In the first place, the advantages which the higher conditions of life are supposed to confer bear no proportion in value to the advantages which are bestowed by nature. The gifts of nature always surpass the gifts of fortune. How much, for example, is activity better than attendance; beauty than dress; appetite, digestion, and tranquil bowels, than all the studies of cookery, or than the most costly compilation of forced or far-fetched dainties!

Nature has a strong tendency to equalisation. Habit, the instrument of nature, is a great leveller; the familiarity which it induces taking off the edge both of our pleasures and our sufferings. Indulgences which are habitual, keep us in ease, and cannot be carried much farther. So that with respect to the gratifications of which the senses are capable, the difference is by no means proportionable to the apparatus. Nay, so far as superfluity generates fastidiousness, the difference is on the wrong side.

It is not necessary to contend, that the advantages derived from wealth are none (under due regulations they are certainly considerable), but that they are not greater than they ought to be. *Money* is the sweetener of human toil; the substitute for coercion; the reconciler of labour with liberty. It is, moreover, the stimulant of enterprise in all projects and undertakings, as well as of diligence in the most beneficial arts and employments. Now, did affluence, when possessed, contribute nothing

to happiness, or nothing beyond the mere supply of necessaries,—and the secret should come to be discovered, —we might be in danger of losing great part of the uses which are at present derived to us through this important medium. Not only would the tranquillity of social life be put in peril by the want of a motive to attach men to their private concerns; but the satisfaction which all men receive from success in their respective occupations, which collectively constitutes the great mass of human comfort, would be done away in its very principle.

With respect to *station*, as it is distinguished from riches, whether it confer authority over others, or be invested with honours which apply solely to sentiment and imagination, the truth is that what is gained by rising through the ranks of life is not more than sufficient to draw forth the exertions of those who are engaged in the pursuits which lead to advancement, and which, in general, are such as ought to be encouraged. Distinctions of this sort are subjects much more of competition than of enjoyment; and in that competition their use consists. It is not, as hath been rightly observed, by what the *Lord Mayor* feels in his coach, but by what the *apprentice* feels who gazes at him, that the public is served.

As we approach the summits of human greatness, the comparison of good and evil, with respect to personal comfort, becomes still more problematical; even allowing to ambition all its pleasures. The poet asks, "What is grandeur, what is power?" The philosopher answers, "Constraint and plague: *et in maximâ quâque fortunâ minimum licere.*" One very common error misleads the opinion of mankind on this head, *viz.* that, universally, authority is pleasant, submission painful. In the general course of human affairs, the very reverse of this is nearer the truth. Command is anxiety, obedience ease.

Artificial distinctions sometimes promote real equality. Whether they be hereditary, or be the homage paid to office, or the respect attached by public opinion to particular professions, they serve to *confront* that grand and unavoidable distinction which arises from property, and

which is most overbearing where there is no other. It is of the nature of property, not only to be irregularly distributed, but to run into large masses. Public laws should be so constructed as to favour its diffusion as much as they can. But all that can be done by laws, consistently with that degree of government of his property which ought to be left to the subject, will not be sufficient to counteract this tendency. There must always, therefore, be the difference between rich and poor; and this difference will be the more grinding when no pretension is allowed to be set up against it.

So that the evils, if evils they must be called, which spring either from the necessary subordinations of civil life, or from the distinctions which have naturally, though not necessarily, grown up in most societies, so long as they are unaccompanied by privileges injurious or oppressive to the rest of the community, are such as may, even by the most depressed ranks, be endured with very little prejudice to their comfort.

The mischiefs of which mankind are the occasion to one another, by their private wickednesses and cruelties; by tyrannical exercises of power; by rebellions against just authority; by wars; by national jealousies and competitions operating to the destruction of third countries; or by other instances of misconduct either in individuals or societies, are all to be resolved into the character of man as a *free agent*. Free agency, in its very essence, contains liability to abuse. Yet, if you deprive man of his free agency, you subvert his nature. You may have order from him and regularity, as you may from the tides or the trade-winds, but you put an end to his moral character, to virtue, to merit, to accountableness, to the use indeed of reason. To which must be added the observation, that even the bad qualities of mankind have an origin in their good ones. The case is this: Human passions are either necessary to human welfare, or capable of being made, and, in a great majority of instances, in fact made, conducive to its happiness. These passions are strong and general; and, perhaps, would not answer their purpose unless they were so. But

strength and generality, when it is expedient that particular circumstances should be respected, become, if left to themselves, excess and misdirection. From which excess and misdirection, the vices of mankind (the causes, no doubt, of much misery) appear to spring. This account, whilst it shows us the principle of vice, shows us, at the same time, the province of reason and of self-government; the want also of every support which can be procured to either from the aids of religion; and it shows this, without having recourse to any native, gratuitous malignity in the human constitution. Mr. Hume, in his posthumous dialogues, asserts, indeed, of *idleness*, or aversion to labour (which he states to lie at the root of a considerable part of the evils which mankind suffer), that it is simply and merely bad. But how does he distinguish idleness from the love of ease? or is he sure, that the love of ease in individuals is not the chief foundation of social tranquillity? It will be found, I believe, to be true, that in every community there is a large class of its members, whose idleness is the best quality about them, being the corrective of other bad ones. If it were possible, in every instance, to give a right determination to industry, we could never have too much of it. But this is not possible, if men are to be free. And without this, nothing would be so dangerous, as an incessant, universal, indefatigable activity. In the civil world, as well as in the material, it is the *vis inertiæ* which keeps things in their places.

NATURAL THEOLOGY has ever been pressed with this question,—Why, under the regency of a supreme and benevolent Will, should there be in the world so much as there is of the appearance of *chance?*

The question in its whole compass lies beyond our reach: but there are not wanting, as in the origin of evil, answers which seem to have considerable weight in particular cases, and also to embrace a considerable number of cases.

I. There must be *chance* in the midst of design: by which we mean, that events which are not designed,

necessarily arise from the pursuit of events which are designed. One man travelling to York, meets another man travelling to London. Their meeting is by chance, is accidental, and so would be called and reckoned, though the journeys which produced the meeting were, both of them, undertaken with design and from deliberation. The meeting, though accidental, was nevertheless hypothetically necessary (which is the only sort of necessity that is intelligible): for if the two journeys were commenced at the time, pursued in the direction, and with the speed, in which and with which they were in fact begun and performed, the meeting could not be avoided. There was not, therefore, the less necessity in it for its being by chance. Again, the rencounter might be most unfortunate, though the errand, upon which each party set out upon his journey, were the most innocent or the most laudable. The by-effect may be unfavourable, without impeachment of the proper purpose, for the sake of which the train, from the operation of which these consequences ensued, was put in motion. Although no cause act without a good purpose, accidental consequences, like these, may be either good or bad.

II. The *appearance of chance* will always bear a proportion to the ignorance of the observer. The cast of a die as regularly follows the laws of motion, as the going of a watch; yet, because we can trace the operation of those laws through the works and movements of the watch, and cannot trace them in the shaking or throwing of the die (though the laws be the same, and prevail equally in both cases), we call the turning up of the number of the die, chance; the pointing of the index of the watch, machinery, order, or by some name which excludes chance. It is the same in those events which depend upon the will of a free and rational agent. The verdict of a jury, the sentence of a judge, the resolution of an assembly, the issue of a contested election, will have more or less the appearance of chance, might be more or less the subject of a wager, according as we were less or more acquainted with the reasons which in-

fluenced the deliberation. The difference resides in the information of the observer, and not in the thing itself; which, in all the cases proposed, proceeds from intelligence, from mind, from counsel, from design.[75]

Now when this one cause of the appearance of chance, *viz.* the ignorance of the observer, comes to be applied to the operations of the Deity, it is easy to foresee how fruitful it must prove of difficulties and of seeming confusion. It is only to think of the Deity, to perceive what variety of objects, what distance of time, what extent of space and action, his counsels may, or rather must, comprehend. Can it be wondered at, that, of the purposes which dwell in such a mind as this, so small a part should be known to us? It is only necessary, therefore, to bear in our thought, that in proportion to the inadequateness of our information, will be the quantity in the world of apparent chance.

III. In a great variety of cases, and of cases comprehending numerous subdivisions, it appears, for many reasons, to be better that events rise up by *chance*, or, more properly speaking, with the appearance of chance, than according to any observable rule whatever. This is not seldom the case even in human arrangements. Each person's place and precedency, in a public meeting, may be determined by *lot*. Work and labour may be *allotted*. Tasks and burdens may be *allotted:*

——— Operumque laborem
Partibus æquabat justis, aut *sorte* trahebat.

Military service and station may be *allotted*. The distribution of provision may be made by *lot*, as it is in a sailor's mess; in some cases also, the distribution of favours may be made by *lot*. In all these cases, it seems to be acknowledged, that there are advantages in permitting events to chance superior to those which would or could arise from regulation. In all these cases also,

[75] See note to p. 55 of vol. ii. respecting Chance. This paragraph is wholly free from the inaccuracy taken notice of in the former note.

though events rise up in the way of chance, it is by appointment that they do so.

In other events, and such as are independent of human will, the reasons for this preference of uncertainty to rule appear to be still stronger. For example: it seems to be expedient that the period of human life should be *uncertain*. Did mortality follow any fixed rule, it would produce a security in those that were at a distance from it, which would lead to the greatest disorders; and a horror in those who approached it, similar to that which a condemned prisoner feels on the night before his execution. But, that death be uncertain, the young must sometimes die, as well as the old. Also were deaths never *sudden*, they who are in health would be too confident of life. The strong and the active, who want most to be warned and checked, would live without apprehension or restraint. On the other hand, were sudden deaths very frequent, the sense of constant jeopardy would interfere too much with the degree of ease and enjoyment intended for us; and human life be too precarious for the business and interests which belong to it. There could not be dependence either upon our own lives, or the lives of those with whom we were connected, sufficient to carry on the regular offices of human society. The manner, therefore, in which death is made to occur, conduces to the purposes of admonition, without overthrowing the necessary stability of human affairs.[76]

Disease being the forerunner of death, there is the same reason for its attacks coming upon us under the ap-

[76] It must never be forgotten that, according to the scheme, whether of Natural or of Revealed Religion, the doctrine of a Future State removes one branch of the evil here treated of, and answers the common sceptical objection grounded upon the destruction of one being made the means of benefit to another. In the view of religion, the person removed by Providence is to be considered as suffering no loss whatever,—he is at once taken to a superior state. The survivors alone are to be considered as regards the question of evil.

pearance of chance, as there is for uncertainty in the time of death itself.

The *seasons* are a mixture of regularity and chance. They are regular enough to authorise expectation, whilst their being in a considerable degree irregular induces, on the part of the cultivators of the soil, a necessity for personal attendance, for activity, vigilance, precaution. It is this necessity which creates farmers; which divides the profit of the soil between the owner and the occupier; which by requiring expedients, by increasing employment, and by rewarding expenditure, promotes agricultural arts and agricultural life, of all modes of life the best, being the most conducive to health, to virtue, to enjoyment. I believe it to be found, in fact, that where the soil is the most fruitful, and the seasons the most constant, there the condition of the cultivators of the earth is the most depressed. Uncertainty, therefore, has its use even to those who sometimes complain of it the most. Seasons of scarcity themselves are not without their advantages.[77] They call forth new exertions; they set contrivance and ingenuity at work; they give birth to improvements in agriculture and œconomy; they promote the investigation and management of public resources.

Again: there are strong intelligible reasons why there should exist in human society great disparity of *wealth* and *station;* not only as these things are acquired in different degrees, but at the first setting out of life. In order, for instance, to answer the various demands of civil life, there ought to be amongst the members of every civil society a diversity of education, which can only belong to an original diversity of circumstances. As this sort of disparity, which ought to take place from the beginning of life, must, *ex hypothesi*, be previous to the merit or demerit of the persons upon whom it falls, can it be better disposed of than by chance? *Parentage* is that sort of chance: yet it is the commanding circum-

[77] See former note upon the only legitimate application of such arguments.

stance which in general fixes each man's place in civil life, along with every thing which appertains to its distinctions. It may be the result of a beneficial rule, that the fortunes or honours of the father devolve upon the son; and, as it should seem, of a still more necessary rule, that the low or laborious condition of the parent be communicated to his family; but with respect to the successor himself, it is the drawing of a ticket in a lottery. Inequalities, therefore, of fortune, at least the greatest part of them, *viz.* those which attend us from our birth, and depend upon our birth, may be left, as they are left, to *chance*, without any just cause for questioning the regency of a supreme Disposer of events.

But not only the donation, when by the necessity of the case they must be gifts, but even the *acquirability* of civil advantages, ought perhaps in a considerable degree to lie at the mercy of chance. Some would have all the virtuous rich, or, at least, removed from the evils of poverty, without perceiving, I suppose, the consequence, that all the poor must be wicked. And how such a society could be kept in subjection to government, has not been shown; for the poor, that is, they who seek their subsistence by constant manual labour, must still form the mass of the community; otherwise the necessary labour of life could not be carried on, the work could not be done, which the wants of mankind in a state of civilization, and still more in a state of refinement, require to be done.

It appears to be also true, that the exigencies of social life call not only for an original diversity of *external* circumstances, but for a mixture of different faculties, tastes, and tempers. Activity and contemplation, restlessness and quiet, courage and timidity, ambition and contentedness, not to say even indolence and dulness, are all wanted in the world, all conduce to the well going on of human affairs, just as the rudder, the sails, and the ballast of a ship, all perform their part in the navigation. Now, since these characters require for their foundation

different original talents, different dispositions, perhaps also different bodily constitutions; and since, likewise, it is apparently expedient, that they be promiscuously scattered amongst the different classes of society,—can the distribution of talents, dispositions, and the constitutions upon which they depend, be better made than by *chance?*

The *opposites* of apparent chance are constancy and sensible interposition; every degree of *secret* direction being consistent with it. Now of *constancy*, or of fixed and known rules, we have seen in some cases the inapplicability; and inconveniences which we do not see, might attend their application in other cases.

Of *sensible* interposition, we may be permitted to remark, that a Providence, always and certainly distinguishable, would be neither more nor less than miracles rendered frequent and common. It is difficult to judge of the state into which this would throw us. It is enough to say, that it would cast us upon a quite different dispensation from that under which we live. It would be a total and radical change. And the change would deeply affect, or perhaps subvert, the whole conduct of human affairs. I can readily believe, that, other circumstances being adapted to it, such a state might be better than our present state. It may be the state of other beings; it may be ours hereafter. But the question with which we are now concerned is, how far it would be consistent with our condition, supposing it in other respects to remain as it is? And in this question there seem to be reasons of great moment on the negative side. For instance: so long as bodily labour continues, on so many accounts, to be necessary for the bulk of mankind, any dependency upon supernatural aid, by unfixing those motives which promote exertion, or by relaxing those habits which engender patient industry, might introduce negligence, inactivity, and disorder, into the most useful occupations of human life; and thereby deteriorate the condition of human life itself.

As moral agents we should experience a still greater

alteration; of which more will be said under the next article.

Although, therefore, the Deity, who possesses the power of winding and turning, as he pleases, the course of causes which issue from himself, do in fact interpose to alter or intercept effects which, without such interposition, would have taken place; yet it is by no means incredible that his Providence, which always rests upon final good, may have made a *reserve* with respect to the manifestation of his interference, a part of the very plan which he has appointed for our terrestrial existence, and a part conformable with, or in some sort required by, other parts of the same plan. It is at any rate evident, that a large and ample province remains for the exercise of Providence without its being naturally perceptible by us; because obscurity, when applied to the interruption of laws, bears a necessary proportion to the imperfection of our knowledge when applied to the laws themselves, or rather to the effects which these laws, under their various and incalculable combinations, would of their own accord produce. And if it be said, that the doctrine of Divine Providence, by reason of the ambiguity under which its exertions present themselves, can be attended with no *practical* influence upon our conduct; that, although we believe ever so firmly that there is a Providence, we must prepare, and provide, and act, as if there were none; I answer, that this is admitted; and that we further allege, that so to prepare, and so to provide, is consistent with the most perfect assurance of the reality of a Providence: and not only so, but that it is, probably, one advantage of the present state of our information, that our provisions and preparations are not disturbed by it. Or if it be still asked, Of what use at all, then, is the doctrine, if it neither alter our measures nor regulate our conduct? I answer again, that it is of the greatest use, but that it is a doctrine of sentiment and piety, not (immediately at least) of action or conduct; that it applies to the consolation of men's minds, to their devotions, to the excitement of gratitude, the support of patience, the keeping alive and the strengthening of

every motive for endeavouring to please our Maker; and that these are great uses.[78]

[78] The views taken in these three paragraphs are most important, and they lead to another of equal moment (if, indeed, they do not include it), respecting the obscurity which hangs over the subject of a Future State. Sceptics have constantly asked,—Why a matter, beyond all comparison the most important and the most interesting to man, should be left in any the least doubt? in other words, Why the combined operation of Natural and Revealed Religion should not be to make us just as certain of what shall befall us upon our removal from this world as we are of what is likely to happen on the morrow of any given day? The answer is,—*because* this matter is so immeasurably more important and more interesting to us than all others; and *because*, unless our whole nature were changed, the absolute certainty of enjoyments without end and without limit would make the performance of our present task impossible. If, indeed, the further question is pressed,—"Why are we so constituted?"—this is only another form of what in truth all these reasonings conceal, the question, Why man was created a finite being? For in this all the sceptical questions of the description adverted to invariably end. Thus, to take an instance from one gratification which of necessity presupposes evil,—There is pleasure in the cessation of pain, and in the enjoyment of rest after labour; as there also is in satisfying the thirst for knowledge. It is not a contingent but a necessary truth, that this gratification of ease, or of curiosity satisfied, cannot be obtained without the preceding evil of suffering or fatigue, or the preceding imperfection of ignorance. But it is said, why might we not have been so made as to have other equal pleasures without the evil? And had such been our constitution, the same objectors would have said,—"Here is one source of enjoyment cut off." Nay, if life were an alternation of positive enjoyment with mere ease, they would still say,—"Why any interval of positive enjoyment, compared with which mere ease is worthless, and so an evil?" And if all were positive enjoyment, they would say,—"Why is it not more exquisite?" in other words,—"Why is man a finite being?" All our speculations, however, upon this subject must proceed upon the assumption that the design of Providence was to create

Of all views under which human life has ever been considered, the most reasonable, in my judgment, is that which regards it as a state of *probation*. If the course of the world was separated from the contrivances of nature, I do not know that it would be necessary to look for any other account of it than what, if it may be called an account, is contained in the answer, that events rise up by chance. But since the contrivances of nature decidedly evince *intention;* and since the course of the world and the contrivances of nature have the same author; we are, by the force of this connexion, led to believe that the appearance under which events take place, is reconcileable with the supposition of design on the part of the Deity. It is enough that they be reconcileable with this supposition; and it is undoubtedly true that they may be reconcileable, though we cannot reconcile them. The mind, however, which contemplates the works of nature, and in those works sees so much of means directed to ends, of beneficial effects brought about by wise expedients, of concerted trains of causes terminating in the happiest results; so much, in a word, of counsel, intention, and benevolence; a mind, I say, drawn into the habit of thought which these observations excite, can hardly turn its view to the condition of our own species without endeavouring to suggest to itself some purpose, some design, for which the state in which we are placed is fitted, and which it is made to serve. Now we assert the most probable supposition to be, that it is a state of moral probation; and that many things in

a finite, mortal creature, endowed with free will, but influenced by motives inducing and dissuading. Any inquiry into the reason for such a determination being .taken by the Supreme Being far exceeds the bounds of our faculties; and the question as to evil must be always handled with the impression that, beyond a certain way, we never can make progress towards its entire solution. The whole subject, with the different doctrines held upon it, will be treated at large in the Appendix, where it will be contended that the most enlarged views lead to the conclusion of rational optimism and a probationary state.

it suit with this hypothesis which suit no other. It is not a state of unmixed happiness, or of happiness simply; it is not a state of designed misery, or of misery simply: it is not a state of retribution; it is not a state of punishment. It suits with none of these suppositions. It accords much better with the idea of its being a condition calculated for the production, exercise, and improvement of moral qualities, with a view to a future state, in which these qualities, after being so produced, exercised, and improved, may, by a new and more favourable constitution of things, receive their reward, or become their own. If it be said, that this is to enter upon a religious rather than a philosophical consideration, I answer, that the name of Religion ought to form no objection if it shall turn out to be the case that the more religious our views are the more probability they contain. The degree of beneficence, of benevolent intention, and of power, exercised in the construction of sensitive beings, goes strongly in favour, not only of a creative, but of a continuing care, that is, of a ruling Providence. The degree of chance which appears to prevail in the world requires to be reconciled with this hypothesis. Now it is one thing to maintain the doctrine of Providence along with that of a future state, and another thing without it. In my opinion, the two doctrines must stand or fall together. For although more of this apparent chance may perhaps, upon other principles, be accounted for than is generally supposed, yet a future state alone rectifies all disorders: and if it can be shown that the appearance of disorder is consistent with the uses of life as a *preparatory* state, or that in some respects it promotes these uses, then, so far as this hypothesis may be accepted, the ground of the difficulty is done away.

In the wide scale of human condition there is not, perhaps, one of its manifold diversities which does not bear upon the design here suggested. Virtue is infinitely various. There is no situation in which a rational being is placed, from that of the best-instructed Christian down to the condition of the rudest barbarian, which affords not room for moral agency,—for the acquisition, exercise,

and display of voluntary qualities, good and bad. Health and sickness, enjoyment and suffering, riches and poverty, knowledge and ignorance, power and subjection, liberty and bondage, civilization and barbarity, have all their offices and duties, all serve for the *formation* of character: for when we speak of a state of trial, it must be remembered that characters are not only tried, or proved, or detected, but that they are generated also and *formed* by circumstances. The best dispositions may subsist under the most depressed, the most afflicted fortunes. A West Indian slave, who, amidst his wrongs, retains his benevolence, I, for my part, look upon as amongst the foremost of human candidates for the rewards of virtue. The kind master of such a slave, that is, he who, in the exercise of an inordinate authority, postpones in any degree his own interest to his slave's comfort, is likewise a meritorious character, but still he is inferior to his slave. All, however, which I contend for is, that these destinies, opposite as they may be in every other view, are both *trials*, and equally such. The observation may be applied to every other condition, to the whole range of the scale, not excepting even its lowest extremity. *Savages* appear to us all alike; but it is owing to the distance at which we view savage life, that we perceive in it no discrimination of character. I make no doubt but that moral qualities, both good and bad, are called into action as much, and that they subsist in as great variety in these inartificial societies, as they are or do in polished life. Certain at least it is, that the good and ill treatment which each individual meets with depends more upon the choice and voluntary conduct of those about him than it does or ought to do under regular civil institutions and the coercion of public laws. So again, to turn our eyes to the other end of the scale, namely, that part of it which is occupied by mankind enjoying the benefits of learning, together with the lights of revelation; there also the advantage is all along *probationary*. Christianity itself, I mean the revelation of Christianity, is not only a blessing, but a trial. It is one of the diversified means by which the character is exercised; and they who require of

Christianity that the revelation of it should be universal, may possibly be found to require that one species of probation should be adopted, if not to the exclusion of others, at least to the narrowing of that variety which the wisdom of the Deity hath appointed to this part of his moral œconomy.*

Now if this supposition be well founded, that is, if it be true that our ultimate or our most permanent happiness will depend, not upon the temporary condition into which we are cast, but upon our behaviour in it, then is it a much more fit subject of *chance* than we usually allow or apprehend it to be, in what manner the variety of external circumstances which subsist in the human world is distributed amongst the individuals of the species. "This life being a state of probation, it is immaterial," says Rousseau, "what kind of trials we experience in it, provided they produce their effects." Of two agents who stand indifferent to the moral Governor of the universe, one may be exercised by riches, the other by poverty. The treatment of these two shall appear to be very opposite, whilst in truth it is the same; for though, in many respects, there be great disparity between the conditions assigned, in one main article there may be none, *viz.* in that they are alike trials, have both their duties and temptations not less arduous or less dangerous in one case than the other: so that if the final award follow the character, the original distribution of the circumstances under which that character is formed may be defended upon principles not only of justice, but of equality. What hinders, therefore, but that mankind

* The reader will observe that I speak of the revelation of Christianity as distinct from Christianity itself. The *dispensation* may already be universal. That part of mankind which never heard of CHRIST'S name, may nevertheless be redeemed, that is, be placed in a better condition, with respect to their future state, by his intervention,—may be the objects of his benignity and intercession, as well as of the propitiatory virtue of his passion. But this is not "natural theology," therefore I will not dwell longer upon it.—*Note of the Author.*

may draw lots for their condition? They take their portion of faculties and opportunities, as any unknown cause, or concourse of causes, or as causes acting for other purposes, may happen to set them out; but the event is governed by that which depends upon themselves, the application of what they have received. In dividing the talents, no rule was observed,—none was necessary; in rewarding the use of them, that of the most correct justice. The chief difference at last appears to be, that the right use of more talents, *i. e.* of a greater trust, will be more highly rewarded than the right use of fewer talents, *i. e.* of a less trust. And since for other purposes it is expedient that there be an inequality of concredited talents here, as well probably as an inequality of conditions hereafter, though all remuneratory,—can any rule adapted to that inequality be more agreeable, even to our apprehensions of distributive justice, than this is?

We have said that the appearance of *casualty* which attends the occurrences and events of life not only does not interfere with its uses, as a state of probation, but that it promotes these uses.

Passive virtues, of all others the severest and the most sublime,—of all others, perhaps, the most acceptable to the Deity,—would, it is evident, be excluded from a constitution in which happiness and misery regularly followed virtue and vice. Patience and composure under distress, affliction, and pain; a steadfast keeping up of our confidence in God, and of our reliance upon his final goodness, at the time when everything present is adverse and discouraging; and (what is no less difficult to retain) a cordial desire for the happiness of others, even when we are deprived of our own; these dispositions, which constitute, perhaps, the perfection of our moral nature, would not have found their proper office and object in a state of avowed retribution, and in which, consequently, endurance of evil would be only submission to punishment.

Again, one man's sufferings may be another man's trial. The family of a sick parent is a school of filial

piety. The charities of domestic life, and not only these, but all the social virtues, are called out by distress. But then misery, to be the proper object of mitigation, or of that benevolence which endeavours to relieve, must be really or apparently casual. It is upon such sufferings alone that benevolence can operate. For were there no evils in the world but what were punishments, properly and intelligibly such, benevolence would only stand in the way of justice. Such evils, consistently with the administration of moral government, could not be prevented or alleviated, that is to say, could not be remitted in whole or in part, except by the authority which inflicted them, or by an appellate or superior authority. This consideration, which is founded in our most acknowledged apprehensions of the nature of penal justice, may possess its weight in the Divine counsels. Virtue, perhaps, is the greatest of all ends. In human beings, relative virtues form a large part of the whole. Now relative virtue presupposes, not only the existence of evil—without which it could have no object, no material to work upon—but that evils be apparently, at least, *misfortunes*, that is, the effects of apparent chance. It may be in pursuance, therefore, and in furtherance of the same scheme of probation, that the evils of life are made so to present themselves.

I have already observed that when we let in religious considerations, we often let in light upon the difficulties of nature. So in the fact now to be accounted for; the *degree* of happiness which we usually enjoy in this life may be better suited to a state of trial and probation than a greater degree would be. The truth is, we are rather too much delighted with the world than too little. Imperfect, broken, and precarious as our pleasures are, they are more than sufficient to attach us to the eager pursuit of them. A regard to a *future* state can hardly keep its place as it is. If we were designed, therefore, to be influenced by that regard, might not a more indulgent system, a higher or more uninterrupted state of gratification, have interfered with the design? At least it seems expedient that mankind should be susceptible of this in-

fluence when presented to them, that the condition of the world should not be such as to exclude its operation, or even to weaken it more than it does. In a religious view (however we may complain of them in every other), privation, disappointment, and satiety, are not without the most salutary tendencies.

CHAPTER XXVII.

CONCLUSION.

In all cases wherein the mind feels itself in danger of being confounded by variety, it is sure to rest upon a few strong points, or perhaps upon a single instance. Amongst a multitude of proofs, it is *one* that does the business. If we observe in any argument that hardly two minds fix upon the same instance, the diversity of choice shows the strength of the argument, because it shows the number and competition of the examples. There is no subject in which the tendency to dwell upon select or single topics is so usual—because there is no subject of which, in its full extent, the latitude is so great—as that of natural history applied to the proof of an intelligent Creator. For my part, I take my stand in human anatomy; and the examples of mechanism I should be apt to draw out from the copious catalogue which it supplies, are the pivot upon which the head turns, the ligaments within the socket of the hip-joint, the pulley or trochlear muscles of the eye, the epiglottis, the bandages which tie down the tendons of the wrist and instep, the slit or perforated muscles at the hands and feet, the knitting of the intestines to the mesentery, the course of the chyle into the blood, and the constitution of the sexes as extended throughout the whole of the animal creation. To these instances the reader's memory will go back, as they are severally set forth in their places: there is not one of the number which I do not think decisive; not one which is not strictly mechanical: nor have I read or heard of any solution of these appearances which in the smallest degree shakes the conclusion that we build upon them.

But of the greatest part of those who, either in this book or any other, read arguments to prove the existence of a God, it will be said that they leave off only where they began; that they were never ignorant of this great truth, never doubted of it; that it does not therefore appear what is gained by researches from which no new opinion is learned, and upon the subject of which no proofs were wanted. Now, I answer that by *investigation* the following points are always gained in favour of doctrines even the most generally acknowledged (supposing them to be true), *viz.* stability and impression. Occasions will arise to try the firmness of our most habitual opinions. And upon these occasions it is a matter of incalculable use to feel our foundation, and find a support in argument for what we had taken up upon authority. In the present case the arguments upon which the conclusion rests are exactly such as a truth of universal concern ought to rest upon. "They are sufficiently open to the views and capacities of the unlearned, at the same time that they acquire new strength and lustre from the discoveries of the learned." If they had been altogether abstruse and recondite, they would not have found their way to the understandings of the mass of mankind; if they had been merely popular, they might have wanted solidity.

But, secondly, what is gained by research in the stability of our conclusion is also gained from it in *impression*.[79] Physicians tell us that there is a great deal of

[79] We have adverted in a former note (Chap. xxv.) to the lamented silence of Laplace upon the inferences to which his most important researches so naturally lead. An objection of a kind in some respects similar, but in others materially different, has often been urged against another class of writers,—the historians who record, without observation, events in which pious men are prone to trace the interposition of Providence. This charge was brought, upon one remarkable occasion, against the narrative of a celebrated voyage of discovery; and the author, Dr. Hawkesworth, defended himself in an elaborate and ingenious manner. He urged that either the event (the ceasing of the wind at a critical

difference between taking a medicine and the medicine getting into the constitution, a difference not unlike which obtains with respect to those great moral propositions which ought to form the directing principles of human conduct. It is one thing to assent to a proposition of this sort; another, and a very different thing, to have properly imbibed its influence. I take the case to be this: perhaps almost every man living has a particular train of thought, into which his mind glides and falls when at leisure from the impressions and ideas that occasionally excite it; perhaps also the train of thought here spoken of, more than any other thing, determines the character. It is of the utmost consequence, therefore, that this property of our constitution be well regulated.

moment, by which Captain Cook's ship, after it had struck on a coral rock, was saved, contrary to all expectation) happened in the ordinary course of nature, and then ought no more to be called providential than the rising of the sun upon any given day; or it was produced by an extraordinary interposition, and then the same power might have rendered this unnecessary, by preventing the ship from striking. (Voyages, vol. i. p. 21, second edition.) But this reasoning proceeds upon an entire misapprehension of the objection. No one denies that the good and the evil come from the same Almighty hand; but resting in the belief, avowed by Dr. Hawkesworth himself in explicit terms, that "the Supreme Being is equally wise and benevolent in the dispensation of both evil and good as means of effecting ultimate purposes worthy of his ineffable perfections" (ib. p. 20), we may, with the most absolute consistency, express thankfulness for the one and resigned submission to the other dispensation; and it is a wholesome habit of thinking, and one according with our duty to that awful and benevolent Being, as well as conducive to our own mental improvement, to make our gratitude for his bounties keep pace with our resignation to his will. Those, therefore, who, like Laplace, pass by an occasion of marking the proofs of his existence and intelligence where it naturally presents itself, expose themselves to blame; and those who, as it were, go out of their way to avoid marking instances of his bounty, are alike censurable. Both classes neglect a fit opportunity of promoting human improvement.

Now it is by frequent or continued meditation upon a subject, by placing a subject in different points of view, by induction of particulars, by variety of examples, by applying principles to the solution of phenomena, by dwelling upon proofs and consequences, that mental exercise is drawn into any particular channel. It is by these means at least that we have any power over it. The train of spontaneous thought, and the choice of that train, may be directed to different ends, and may appear to be more or less judiciously fixed, according to the purpose in respect of which we consider it; but, in a *moral view*, I shall not, I believe, be contradicted when I say, that if one train of thinking be more desirable than another, it is that which regards the phenomena of nature with a constant reference to a supreme, intelligent Author. To have made this the ruling, the habitual sentiment of our minds, is to have laid the foundation of everything which is religious. The world thenceforth becomes a temple, and life itself one continued act of adoration. The change is no less than this; that, whereas formerly God was seldom in our thoughts, we can now scarcely look upon anything without perceiving its relation to him. Every organised natural body, in the provisions which it contains for its sustentation and propagation, testifies a care on the part of the Creator expressly directed to these purposes. We are on all sides surrounded by such bodies; examined in their parts, wonderfully curious; compared with one another, no less wonderfully diversified. So that the mind, as well as the eye, may either expatiate in variety and multitude, or fix itself down to the investigation of particular divisions of the science. And in either case it will rise up from its occupation, possessed by the subject, in a very different manner, and with a very different degree of influence, from what a mere assent to any verbal proposition which can be formed concerning the existence of the Deity, at least that merely complying assent with which those about us are satisfied, and with which we are too apt to satisfy ourselves, will or can produce upon the thoughts. More especially may this difference be per-

ceived in the degree of admiration and of awe with which the Divinity is regarded when represented to the understanding by its own remarks, its own reflections, and its own reasonings, compared with what is excited by any language that can be used by others. The works of nature want only to be contemplated. When contemplated, they have everything in them which can astonish by their greatness; for, of the vast scale of operation through which our discoveries carry us, at one end we see an intelligent Power arranging planetary systems, fixing, for instance, the trajectory of *Saturn*, or constructing a ring of two hundred thousand miles' diameter, to surround his body, and be suspended like a magnificent arch over the heads of his inhabitants; and at the other bending a hooked tooth, concerting and providing an appropriate mechanism for the clasping and reclasping of the filaments of the feather of the humming-bird. We have proof, not only of both these works proceeding from an intelligent agent, but of their proceeding from the same agent; for, in the first place, we can trace an identity of plan, a connexion of system, from Saturn to our own globe; and when arrived upon our globe, we can, in the second place, pursue the connexion through all the organised, especially the animated, bodies which it supports. We can observe marks of a common relation, as well to one another as to the elements of which their habitation is composed. Therefore, one mind hath planned, or at least hath prescribed a general plan for all these productions. One Being has been concerned in all.

Under this stupendous Being we live. Our happiness, our existence, is in his hands. All we expect must come from him. Nor ought we to feel our situation insecure. In every nature, and in every portion of nature, which we can descry, we find attention bestowed upon even the minutest parts. The hinges in the wings of an *earwig*, and the joints of its antennæ, are as highly wrought as if the Creator had had nothing else to finish. We see no signs of diminution of care by multiplicity of objects, or of distraction of thought by variety. We

have no reason to fear, therefore, our being forgotten, or overlooked, or neglected.[80]

The existence and character of the Deity is, in every view, the most interesting of all human speculations. In none, however, is it more so, than as it facilitates the belief of the fundamental articles of *Revelation*. It is a step to have it proved, that there must be something in the world more than what we see. It is a farther step to know that, amongst the invisible things of nature, there must be an intelligent mind, concerned in its production, order, and support. These points being assured to us by Natural Theology, we may well leave to Revelation the disclosure of many particulars, which our researches cannot reach, respecting either the nature of this Being as the original cause of all things, or his character and designs as a moral governor; and not only so, but the more full confirmation of other particulars, of which, though they do not lie altogether beyond our reasonings and our probabilities, the certainty is by no means equal to the importance. The true theist will be the first to listen to *any* credible communication of Divine knowledge. Nothing which he has learnt from Natural Theology will diminish his desire of further instruction, or his disposition to receive it with humility and thankfulness. He wishes for light: he rejoices in light. His inward veneration of this great Being will incline him to attend with the utmost seriousness, not

[80] There is assuredly nothing that more tends to absorb our whole faculties in devout admiration than the contemplation of that universal power and pervading skill which is here remarked by the author. The same Being that fashioned the insect whose existence is only discerned by a microscope, and gave that invisible speck a system of ducts and other organs to perform its vital functions, created the enormous mass of the planet thirteen hundred times larger than our earth, and launched it in its course round the sun, —and the comet, wheeling with a velocity that would carry it round our globe in less than two minutes of time, and yet revolving through so prodigious a space that it takes near six centuries to encircle the sun!

only to all that can be discovered concerning him by researches into nature, but to all that is taught by a revelation which gives reasonable proof of having proceeded from him.

But, above every other article of revealed religion, does the anterior belief of a Deity bear with the strongest force upon that grand point, which gives indeed interest and importance to all the rest,—the resurrection of the human dead. The thing might appear hopeless, did we not see a power at work adequate to the effect, a power under the guidance of an intelligent will, and a power penetrating the inmost recesses of all substance. I am far from justifying the opinion of those who "thought it a thing incredible that God should raise the dead:" but I admit that it is first necessary to be persuaded, that there *is* a God to do so. This being thoroughly settled in our minds, there seems to be nothing in this process (concealed as we confess it to be) which need to shock our belief. They who have taken up the opinion that the acts of the human mind depend upon *organisation*, that the mind itself indeed consists in organisation, are supposed to find a greater difficulty than others do in admitting a transition by death to a new state of sentient existence, because the old organisation is apparently dissolved. But I do not see that any impracticability need be apprehended even by these; or that the change, even upon their hypothesis, is far removed from the analogy of some other operations which we know with certainty that the Deity is carrying on. In the ordinary derivation of plants and animals from one another, a particle, in many cases, minuter than all assignable, all conceivable dimension,—an aura, an effluvium, an infinitesimal,—determines the organisation of a future body: does no less than fix, whether that which is about to be produced shall be a vegetable, a merely sentient, or a rational being; an oak, a frog, or a philosopher; makes all these differences; gives to the future body its qualities, and nature, and species. And this particle, from which springs, and by which is determined, a whole future nature, itself proceeds from, and owes its constitution to,

a prior body: nevertheless, which is seen in plants most decisively, the incepted organisation, though formed within, and through, and by, a preceding organisation, is not corrupted by its corruption, or destroyed by its dissolution: but, on the contrary, is sometimes extricated and developed by those very causes; survives and comes into action, when the purpose for which it was prepared requires its use. Now an economy which nature has adopted, when the purpose was to transfer an organisation from one individual to another, may have something analogous to it when the purpose is to transmit an organisation from one state of being to another state: and they who found thought in organisation may see something in this analogy applicable to their difficulties; for whatever can transmit a similarity of organisation will answer their purpose, because, according even to their own theory, it may be the vehicle of consciousness, and because consciousness carries identity and individuality along with it through all changes of form or of visible qualities. In the most general case, that, as we have said, of the derivation of plants and animals from one another, the latent organisation is either itself similar to the old organisation, or has the power of communicating to new matter the old organic form. But it is not restricted to this rule. There are other cases, especially in the progress of insect life, in which the dormant organisation does not much resemble that which encloses it, and still less suits with the situation in which the enclosing body is placed, but suits with a different situation to which it is destined. In the larva of the libellula, which lives constantly, and has still long to live under water, are descried the wings of a fly, which two years afterwards is to mount into the air. Is there nothing in this analogy? It serves at least to show, that, even in the observable course of nature, organisations are formed one beneath another; and, amongst a thousand other instances, it shows completely that the Deity can mould and fashion the parts of material nature, so as to fulfil any purpose whatever which he is pleased to appoint.

They who refer the operations of mind to a substance

totally and essentially different from matter (as most certainly these operations, though affected by material causes, hold very little affinity to any properties of matter with which we are acquainted), adopt perhaps a juster reasoning and a better philosophy: and by these the considerations above suggested are not wanted, at least in the same degree. But to such as find, which some persons do find, an insuperable difficulty in shaking off an adherence to those analogies, which the corporeal world is continually suggesting to their thoughts; to such, I say, every consideration will be a relief, which manifests the extent of that intelligent power which is acting in nature, the fruitfulness of its resources, the variety, and aptness, and success of its means; most especially every consideration which tends to show that, in the translation of a conscious existence, there is not, even in their own way of regarding it, any thing greatly beyond, or totally unlike, what takes place in such parts (probably small parts) of the order of nature, as are accessible to our observation.

Again: if there be those who think that the contractedness and debility of the human faculties in our present state seem ill to accord with the high destinies which the expectations of religion point out to us; I would only ask them, whether any one who saw a child two hours after its birth could suppose that it would ever come to understand *fluxions*;* or who then shall say, what further amplification of intellectual powers, what accession of knowledge, what advance and improvement, the rational faculty, be its constitution what it will, may not admit of when placed amidst new objects, and endowed with a sensorium adapted, as it undoubtedly will be, and as our present senses are, to the perception of those substances and of those properties of things with which our concern may lie.

Upon the whole: in every thing which respects this awful, but, as we trust, glorious change, we have a wise and powerful Being (the author, in nature, of infinitely

* See Search's Light of Nature, *passim*.

various expedients for infinitely various ends), upon whom to rely for the choice and appointment of means adequate to the execution of any plan which his goodness or his justice may have formed for the moral and accountable part of his terrestrial creation. That great office rests with *him:* be it *ours* to hope and to prepare, under a firm and settled persuasion, that living and dying we are his; that life is passed in his constant presence, that death resigns us to his merciful disposal.

END OF VOLUME THE THIRD.

LONDON: WILLIAM CLOWES AND SONS, STAMFORD STREET

University of California
SOUTHERN REGIONAL LIBRARY FACILITY
305 De Neve Drive - Parking Lot 17 • Box 951388
LOS ANGELES, CALIFORNIA 90095-1388

Return this material to the library from which it was borrowed.

6/30/08

3 1205 00365 5444

UC SOUTHERN REGIONAL LIBRARY FACILITY

B 000 009 679 2

Uni